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Journal of Occupational Medicine

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*Shane, S. J., Krzyski, T. K., and Copp, S. E.: Canad. M.A.J. 77:600 (Sept. 15) 1957.

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The Industrial Medical Association was organized in 1915 as the American Association of Industrial Physicians and Surgeons. Its first annual meeting was held the following year. In 1951 the present name was adopted.

The purposes of the organization as stated in the certificate of incorporation (not-for-profit) are:

"The object of this Association will be to foster the study and discussion of the problems peculiar to industrial medicine and surgery; to develop methods adapted to the conservation of health among workers in the industries; to promote a more general understanding of the purposes of the medical care for employees; and to unite into one organization members of the medical profession specializing in industrial medicine and surgery for their mutual advancement in the practice of their profession."

Presently, the membership totals nearly 4000 physicians in the United States, Canada, Latin America, and other parts of the world. Physicians "who have an interest in Industrial Medicine" may apply for membership; specialization in this field is not essential. Regionally, the Industrial Medical Association has 14 Component Societies in the United States. Most Association members carry their membership through one of the component groups.

The Journal of Occupational Medicine, owned and published by the Industrial Medical Association, is sent monthly to each member as one of the advantages of membership.

The annual business meeting and convention is held in the spring. Since 1945, the convention has been held concurrently with the meetings of four other organizations having related interests—American Industrial Hygiene Association, American Conference of Governmental Industrial Hygienists, American Association of Industrial Nurses, Inc., American Association of Industrial Dentists. This combined meeting is known as the Industrial Health Conference.

The Occupational Health Institute, Inc., is a nonprofit educational organization created by the Industrial Medical Association to promote the cause of health in industry. Since 1951, the Occupational Health Institute has conducted the program of evaluation, approval and certification of Medical Services in Industry, on the basis of standards established by the Standards Committee of the Industrial Medical Association. This program was conducted by the American College of Surgeons for many years until its transfer to the Association.

The Association's headquarters office serves as a focal point for the Association's activities, and through its coordination of information regarding industrial health problems encountered throughout the country, it offers invaluable assistance to members on a host of specific subjects.

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Through its District Counselors, the Industrial Medical Association is represented regionally throughout the United States and Canada. Each district is served by a Counselor appointed by the President of the Association. The District Counselor reflects the attitude of the membership of his district in his relations with the national organization, and in turn, reports and interprets policies of the Association to the membership and the general public in his district.

An important function of the District Counselor is to serve in a liaison capacity with the Component Society of the Industrial Medical Association in his area. The District Counselor also is concerned with regional trends in industrial medical practice and in legislation bearing upon medical service in industry. He is ready to assist any physician with questions or problems.

In promoting the cause of industrial medicine, many District Counselors work with the industrial health committees of their state medical societies, they participate in teaching programs at hospitals or medical schools, and serve as speakers at meetings of groups that express interest in occupational health. Throughout these activities, the District Counselor attempts to stimulate membership in the Industrial Medical Association by acquainting others with the organization's purposes and facilities.

By keeping in close contact with members in his area, the District Counselor gains a familiarity with their work which enables him to make recommendations to the Association's officers and committees regarding those qualified for various positions or honors. He recommends members for committee work, and for fellowship, and recommends fellows for consideration for elective offices in the Association. He also recommends possible recipients for the awards presented at the annual meeting of the Association—the Knudsen Award, the Health Achievement in Industry Award, the Meritorious Service Award and the Merit in Authorship Award.

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ANNUAL MEETING & INDUSTRIAL HEALTH CONFERENCE

War Memorial Auditorium, Rochester, N. Y. **April 26 to 29, 1960**

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Association Activities

Preliminary Program for 45th Annual Meeting Rochester, New York, April 24 through 28, 1960

Sunday All Day

Industrial Medical Association Board of Directors will meet with District Counselors, Committee Chairmen, Component Society officers, and the candidates for the Board of Directors.

Monday Afternoon

Plant tours will start from the lobby of the Manger Hotel. Reservations must be made before April 15 with ROBERT L. RALEIGH, M.D., Kodak Park Medical Department, 1669 Lake Ave., Rochester 15, N.Y.

PLANT TOURS:

Atomic Energy Project at the University of Rochester
Bausch and Lomb Optical Company
Delco Appliance Division of General Motors
Eastman Kodak Company (1) Kodak office and Camera Works (2) Kodak Park
Gleason Works
Rochester Products Division of General Motors
Stromberg Carlson Division, General Dynamics Corporation

Tuesday Morning

CLINICS:

Fracture Clinic at Rochester General Hospital (Northside Division)—M. LAURENS ROWE M.D., Chairman.
Surgical Clinic at Strong Memorial Hospital — STANLEY W. WIDGER, M.D., Chairman.
"The Changing Picture of Hand Injuries in Industry"—ROBERT M. MCCORMACK, M.D.
"Problems of Tetanus in Industry with Particular Reference to Immunization Programs"—CHARLES E. SHERMAN, M.D.
"The Healing of Burns" — J. RAYMOND HINSHAW, M.D.
Medical Clinic at Strong Memorial Hospital—NORMAN J. ASHENBURG, M.D., Chairman.
"Predicting the Course of Heart Disease"—GEORGE R. LOVELL, M.D.
"Hematology Clinic—The Diagnosis of Anemia"—SCOTT N. SWISHER, JR., M.D.
"The Pain-Prone Patient" — GEORGE L. ENGEL, M.D.
Dermatology Clinic at War Memorial Auditorium—RAYMOND R. SUSKIND, M.D., Chairman.

Tuesday Afternoon

GENERAL SESSION:

Opening Remarks—D. JOHN LAUER, M.D., IMA President.
Address of Welcome—HON. PETER BARRY, Mayor of Rochester, N.Y.
Sappington Memorial Lecture — "Industrial Medicine — What It Takes" — WILLIAM SHEPARD, M.D.
Panel Presentation—"Medical Care in Industry" — ASA BARNES, M.D., Chairman.

Wednesday Morning

Medical and Surgical Sections (Joint Session) — FREDERICK D. HUGHES, M.D., Chairman.
"Heart Disease and Workmen's Compensation—Discussion of a Hypothetical Case" — Mock Trial.

Wednesday Afternoon

Medical and Surgical Sections (Joint Session)—W. DAGGETT NORWOOD, M.D., Chairman.
Panel Discussion — "Radiation Injury and Workmen's Compensation."
ANNUAL BUSINESS MEETING.

Welcome Ladies

1960 INDUSTRIAL HEALTH CONFERENCE

Rochester, New York — April 25 through 28

Ladies' Entertainment Program

Hospitality Rooms:

Manger Hotel, Lilac Room—Mezzanine, April 25-29

Powers Hotel, Parlor E, April 26-28

Monday	9:00 A.M. to 5:00 P.M.—Registration 3:00 P.M.—Get-Acquainted Hour, Lilac Room, Manger Hotel. Coffee will be served.
Tuesday	9:45 A.M.—Bus tour of the city. 12:00 Noon—Luncheon at Rochester Academy of Medicine. 2:00 P.M.—Tour of Eastman House, Photographic Museum.
Wednesday	12:00 Noon—IMA Presidents' Wives Luncheon—Chatter-box Club. 12:15 P.M.—AIHA Luncheon and Fashion Show at Sibley's Tower Restaurant, followed by a tour "behind the scenes" in Rochester's largest department store. 2:30 P.M.—Tour of Memorial Art Gallery. "April in Rochester" featuring contemporary rooms by Rochester's leading decorators.
Thursday	10:00 A.M. to 3:00 P.M.—Tour through the locks of the Barge Canal. Box luncheon served aboard.

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References: 1. Lichtman, A. L.: Scientific Exhibit, meeting of the International College of Surgeons, Miami Beach, Fla., Jan. 4-7, 1959. 2. Mullin, W. G., and Epifano, Leonard: *Am. Pract. & Digest Treat.* 10:1743, Oct., 1959. 3. Ganz, S. E.: *J. Indiana M. A.* 52:1134, July, 1959. 4. DeNyse, D. L.: *M. Times* 87:1512, Nov., 1959. 5. Shanaphy, J. F.: *Current Therap. Res.* 1:59, Oct., 1959. 6. Stough, A. R.: *J. Oklahoma M. A.* 52:575, Sept., 1959.

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Association Activities

Wednesday Evening

ANNUAL BANQUET. Speaker: THE HONORABLE ARTHUR A. FLEMMING, Secretary, U.S. Department of Health, Education and Welfare.

Thursday Morning

MEDICAL SECTION—D. W. CALDWELL, M.D., Chairman.
Mental Health Presentation (Role-playing program).

SURGICAL SECTION — N. GILLMOR LONG, M.D., Chairman.
"Congenital Defects of the Lumbosacral Spine and Injuries of the Low Back" — JOHN G. HIPPS, M.D.
"Newer Concepts of Low Back Pain" — M. LAURENS ROWE, M.D.

MEDICAL SECTION—LOGAN T. ROBERTSON, M.D., Chairman.
"Periodic Health Examinations and Long Term Follow-Up, 1949 to 1959" — JOHN M. LYNCH, M.D.

SURGICAL SECTION — Chairman to be announced.
"Cancer Detection in Industry" —EDWIN D. SAVLOV, M.D.,
"Natural History of Cancer of the Lung"—CHARLES E. SHERWOOD, M.D., GEORGE L. EMERSON, M.D., and MARION S. EMERSON, M.D.

Thursday Afternoon

MEDICAL SECTION—JOHN L. NORRIS, M.D., Chairman.
"Problem Drinking" — JOHN F. JELLEMA, M.D.
"Standards for Motor Vehicle Driving" — HAROLD BRANDALEONE, M.D.

SURGICAL SECTION — MAX N. HOWARD, M.D., Chairman.
"Management of Mass Casualty Station"—Panel Discussion.

Clinical Conference — FRANK PRINCI, M.D., Chairman.

Scientific Exhibits

Nineteen scientific exhibits will be on display. Titles of the exhibits and the person or organization responsible for each is listed below:

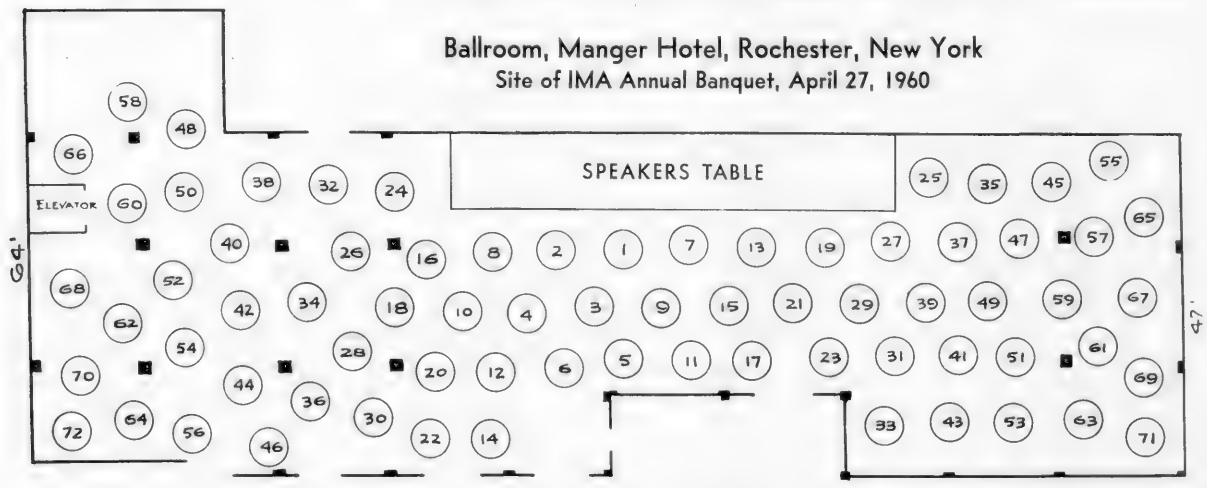
"Traumatic Affections of the Shoulder" — EUGENE G. LIPOW, M.D.; "Crutches and Their Use"—HENRY V. MORELEWICZ, M.D.; "Warning Labels" — JAMES D. KITTELTON; "Activities of the U.S. Air Force Epidemiological Laboratory" —COL. THADDEUS J. DOMANSKI; "Physician's Responsibility in Highway Accidents" — SEWARD MILLER, M.D.; "Bagassosis — A Medical Enigma"—HOWARD A. BUECHNER, M.D.; "Industrial Psychiatry in a Hosiery Mill" — RICHARD C. PROCTOR, M.D.; "Radiological Health Program of the U.S. Army"—COL. ADAM J. RAPALSKI, MC; "Microbiological Safety"—GARDNER G. GREMILLION; "Anthracosilicosis"—RICHARD T. CATHCART, M.D.; "Radiation Protection in the Healing Arts" — Pennsylvania Department of Health; "Pneumoconiosis Prevention Program in Bituminous Coal Mines"—Pennsylvania Department of Health; "Psychiatry at Work"—Committee on Occupational Psychiatry, A.P.A.; "Cancer Detection in Well Adults" — EMERSON DAY, M.D.; "The Red Eye—Differential Diagnosis and Treatment"—ARNOLD S. BREAKEY, M.D.; "The 'Ruster' in Industry"—WILLIAM R. BUCKLEY, M.D.; "Nutrition Nonsense" — MARY JANE KIBLER; "A Punched Card System for Recording and Storing Noise Level Data" —DAVID J. CHAMBERLAIN; "Health Education in Industry" — MELVIN M. UDEL, M.D.

Secretary Flemming to Speak at IMA Banquet

The Honorable ARTHUR A. FLEMMING, Secretary, U.S. Department of Health, Education and Welfare, will be the speaker at the IMA annual banquet to be held in the ballroom of the Manger Hotel, Rochester, N. Y., at 7 P.M. on April 27, 1960.

Advance reservations will be accepted until April 15, according to GORDON M. HEMMETT, M.D., Banquet Committee Chairman. Each table will seat eight persons and the cost is $10.00 per ticket. Reservations, specifying table desired (see floor plan), should be sent to the Industrial Medical Association, 28 E. Jackson, Chicago 4, and should be accompanied by remittance. Places will be assigned in order of receipt of applications. Tables 1, 2, 7, 8, 13 and 19 are not available as they have been assigned to IMA directors and their wives distinguished guests and wives of individuals seated at the speakers' table.

Tickets may also be purchased at the registration desks, Manger Hotel on Monday, or War Memorial Auditorium on Tuesday.



Journal of Occupational Medicine

WORK IN COLD ENVIRONMENTS

Cold and Its Influence on the Worker

E. A. Sellers, M.D., Ph.D., Toronto, Ont.

INDUSTRIAL and military developments in the northern Subarctic and Arctic have made the subject of cold and its influence on the worker of wide interest to those concerned with occupational medicine. Expansion of these developments already planned will make this interest a practical one for more and more physicians. Like many developing fields, the subject is one in which fact, fancy, and fad are inextricably woven. It has been stated that every person is an expert on food and on clothing, and both these subjects have attracted their share of controversy in relation to working in the cold. Other subjects, such as acclimatization, manual dexterity under cold ambient conditions, and the particular problems associated with working in relative isolation, are of equal importance.

There follows in this issue of the JOURNAL a series of articles designed to review current views on these and other subjects. These contributions come from active laboratories which are playing a prominent part in studies of the effects of cold on humans and on animals.

The effect of environmental temperature on man has always been of subjective interest, because of the evident effects ambient conditions have on personal comfort, on ability to work, and on ability to undertake certain types of work. During World War II knowledge of the effects of heat on man was advanced greatly, and since that time great effort has been expended, and considerable progress has been made in studies on the effects of cold. From a restricted field which occupied the attention of a few scientists, it has expanded to a broad area of concern in scores of laboratories, involving several thousand scientific workers. In the United States the Department of Defense and the U.S. Public Health Service, have supported laboratory and field investigations from the Antarctic to Alaska, from Europe to Korea. The National Research Council, the Josiah Macy, Jr. Foundation, the Federation of American Societies for Experimental Biology, and other private organizations have contributed in appropriate fashion. Shortly after World War II this field was chosen by the Defence Research Board of Canada as a major biological interest, and much of the rapid expansion described can be attributed directly or indirectly to encouragement by the Board. The National Research Council of Canada and the Armed Services have participated. In the United Kingdom work done with the support of the Medical Research Council and the Services has received wide acceptance and recognition. Much of the knowledge acquired has been by animal experimentation, and the application of the findings to man has not been easy.

The purpose of this introductory paper is to mention some of the obvious discrepancies which exist in applying the results of experiments with animals to man. In principle many of the comments are applicable to studies of any "different" environment.

The human working in the cold is subject

From the Department of Pharmacology, University of Toronto.

to desiderata partly under his own control, a situation not encountered by animals. Most of these decisions are made with more reference to sociological factors than to physiological changes affecting work.

Investigators in this field have appreciated that sociological problems have made the scientific study of work in cold temperatures complex. It is apparent that the human is a very adaptable animal; in difficult situations he restricts his activities to essentials (which can be interpreted in a variety of ways) but at the same time learns to make the most of available facilities. Within limits he gets along with what he has. This latter consideration extends to use of food, clothing, housing, tools, and so on. For example, the Eskimo with a high-fat, high-protein diet available (seal, walrus, caribou) eats this diet in large quantities. If food with a high content of carbohydrate becomes available his diet is altered.[1] The success with which man adapts sociologically depends on the group he is with, and the social or cultural background to which he is accustomed.

In the laboratory, efforts are usually made to obviate or at least control such factors, and it is not unexpected that often experimental results do not appear to agree with the human "field trial." Indeed, as the field has expanded, it is surprising that differences have not been greater. A pit into which the unwary may fall is to believe that results from the laboratory obtained under specific conditions may be applied directly in the field where very different conditions pertain.

From the standpoint of the biological scientist interested in the busines of living in a cold environment, what has been discovered? A major advance has been that a type of acclimatization (termed acclimation by some) to cold has been shown to exist, and this adaptative process increases the resistance of the animal to cold very greatly.[2-4] Under laboratory conditions—usually exposure to a temperature just above freezing, without nesting material, in individual cages to prevent "huddling"—a major adaptation takes place in rats, mice, rabbits, and guinea pigs. Under such conditions heat production is more than doubled, consumption of food is almost doubled, and growth occurs but at a slower rate than normal. Tissue metabolism is altered; oxygen consumption is increased, but some metabolic processes proceed at a slower rate. This change in tissue metabolism appears to be important in maintaining heat balance, because the acclimatized animals can maintain their body temperature without shivering. This is proof of an old hypothesis—an increased "chemical" thermogenesis as opposed to physical thermogenesis (muscular movement).[5, 6]

The human is seldom exposed to such stringent climatic conditions, and thus one would not expect that changes would occur in the same degree. In spite of this, many changes of a similar nature have been shown to occur in humans.[7]

One major difference between man and common laboratory animals which is often cited is the observation that humans consume little or no more food under cold conditions than in a temperate climate. This difference is more apparent than real. In any animal, human or otherwise, the intake of energy-producing material must equal the output (including storage) of energy. This output is made up of "basal" heat production and work; about 70% of the metabolic energy of work takes the form of heat, which may be used for maintenance of body temperature and otherwise is dissipated. The stored energy (only part of which is available) takes the form of body tissue. The fact that an animal increases its food intake to balance its energy expenditure in the cold has no more significance than the same observation on a man varying his work output from a low to a high value. This comment omits the question of utilization of food energy, which, while of importance, would affect the total balance relatively little.

An important part of the whole process of acclimatization consists in the development of local resistance to cold injury.[4] It can be shown that in animals acclimatized to cold, frostbite and other indications of cold injury do not occur to the same extent, or at as high temperatures, as in nonacclimatized controls. There is considerable evidence that this finding is applicable to humans. Nevertheless, the increased resistance is one of degree and does not obviate the need for properly designed tools for use in extreme cold or protective covering for the extremities or, in the case of extreme cold, even suggest that they could be eliminated.

The same remarks pertain to protective clothing. Added insulation in the form of clothing is necessary at low temperatures and increases comfort in more moderate conditions. Depending on the individual, his work-load, his possible acclimatization, and the ambient temperature, the amount of insulation required will vary. The attempt to meet such a variable requirement without sacrificing mobility has evoked many solutions, which are discussed in this and the succeeding issue. The amount

of water in the form of liquid or vapor on either side of the insulation adds to this particular problem.

In summary, one might say that in the human, acclimatization can, and does, occur, but in extreme cold the relative importance of this to other factors is small.

Another major development in this field is in the appreciation of the large variation of temperature in different parts of the body during exposure to cold. The concept of a uniform "core-temperature," but a large variability in superficial parts including the extremities), has contributed to knowledge of body temperature and the neurocirculatory control which makes this possible.[8, 9] The modifications of these controls during work, and with acclimatization, are as yet imperfectly understood. The importance of both sensory and motor components of such controls is obvious. It is also clear that such controls affect the occurrence of cold injury in an important degree.

These general remarks are not intended to deprecate experiments carried out in the laboratory under defined conditions on man or on species other than man. They are intended to point out the variable conditions under which man is expected to work, variables which can be imperfectly duplicated in the laboratory. These include variables in temperature, air movement, humidity, workload, and sociological status. Changes in any one of these, under certain conditions, may affect work output in a major degree. Work in the cold cannot be considered purely as a problem of ergonomics, unless this term is interpreted in a very broad sense. The studies of groups of men undertaking expeditions in cold weather illustrate the interplay of the many factors involved.

A greater understanding of fundamental physiological changes in cold may be anticipated. However, a knowledge of how to live in the cold and an ability to adapt sociologically is more important than any physiological changes likely to occur. In this the design engineer, the sociologist, the textile physicist, as well as the physician concerned with occupational medicine will play a part.

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Polar Expeditions as Human Laboratories

R. Goldsmith, M.B., B.Ch., and H. E. Lewis, M.B., Ch.B., London, England

THE ADVANCE of industry into northern Canada and Europe, entailing permanent settlement of these regions, brings with it a necessity to know just how efficiently men and machines can work not only for a short but also for extended periods of time in these harsh environments. It is true that indigenous communities like Eskimos and Laplanders live successfully in high latitudes, but in Canada there is the problem of the effect of the polar environment on men (and their families) who have been used to the comfort and the society of organized communities in the lower latitudes. In other words, the problem is no longer the concern of the sourdough and his mystique but of ordinary men who have had no experience of living in extreme climates.

During the past few years, several expeditions have left Britain for the Arctic and Antarctic regions. On these there has been the opportunity to observe and record the behavior of men living for long periods in adverse climatic conditions. In fact, the small polar expedition can be looked upon as a laboratory for industrial settlement.

The Medical Research Council has been especially interested in studying the way in which man adapts himself to the extreme cold, both physiologically and psychologically. An understanding of these mechanisms can be acquired more easily in small well-circumscribed polar expeditions than in the hectic life of a mine or building project.

In the last decade, four major British polar expeditions have been in the field; their work has been mainly exploration and geophysical research, but observations and experiments have been made on human behavior under the unusual stress imposed by the conditions. The Falkland Islands Dependencies Survey (F.I.D.S.)[1] has had stations in the Graham Land Peninsula (Palmer Peninsula for almost 15 years (Fig. 1). This section of the Antarctic, like the main part of the continent, is characterized by a very low yearly mean temperature, differing from the Canadian Arctic in that the summer temperature does not rise much above freezing. These stations all conform to a pattern: The men are housed in small wooden huts suitable for 6-12 persons; the larger stations have a doctor. The men arrive at the stations in summer (December-February) and are then completely isolated until the following year. Each individual usually remains in the Antarctic for two years. His only contact with home is the relief ship at the end of the first year, and the radio during the rest of the period. The work done at these stations consists primarily of survey and geology, and travel is accomplished with the aid of dogs. Meteorology and ionospheric investigations, together with some biological work, usually complete the program.

Farther south a base was established in 1955 by the Royal Society for the International Geophysical Year (I.G.Y.).[2] This, too, has now become a permanent station; it is situated at Halley Bay (75° 28′S), where the conditions are much severer. Travel is restricted from this base because access to the hinterland is almost impossible. The work there has been mainly geophysical. This does not require much work out of doors.

The other two expeditions, the British North Greenland Expedition (B.N.G.E.)[3] 1952-1954 (Fig. 2), and the Commonwealth Trans-Antarctic Expedition (T.A.E.)[4] 1955-1958, have been of quite different character. Their aims have been largely exploratory, necessitating long travel. The first completed a seismic and leveling traverse of North Greenland, while the second crossed Antarctica, making seismic and gravimetric observations en route.

The living conditions in these expeditions were extremely primitive. The base huts are necessarily as cheap as possible, for the restricted sums of money available are better spent on the scientific programs. In the case of the Trans-Antarctic Expedition, as a result

From the Division of Human Physiology, National Institute for Medical Research.

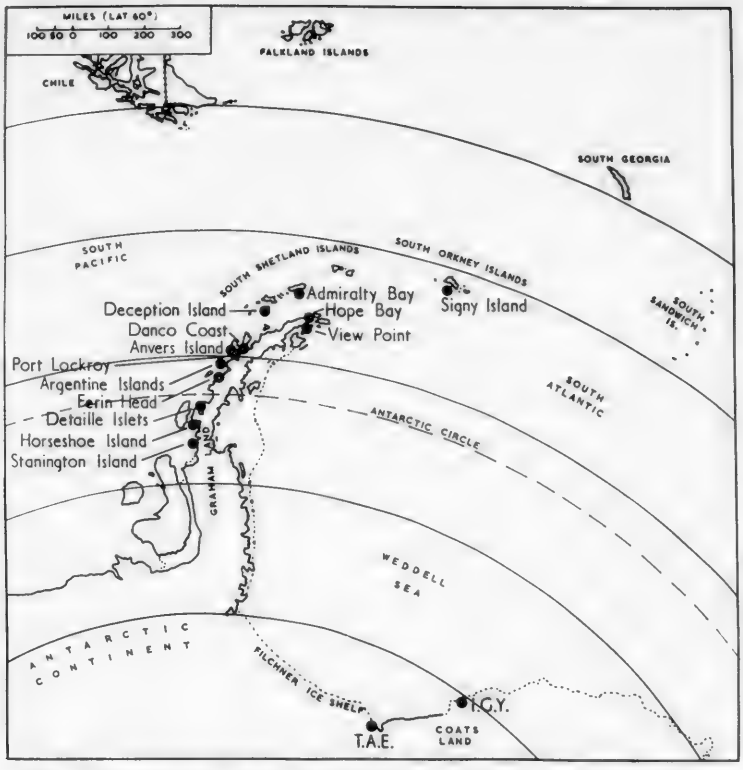

Fig. 1—Distribution of the F.I.D.S. bases on the Graham Land Peninsula and the two bases on the continent proper.

of accidents, even these relatively meager comforts of life were denied to the first-year party.[5] On long overland journeys with vehicles, or shorter ones with dogs, there is stringent restriction on weight, and again the luxuries are left behind in favor of apparatus.

Apart from the scientific programs to be carried out, it was also necessary to set up and keep house. The first field phase of any of these expeditions was one of intense physical effort to unload stores and to build the permanent shelters. The unloading on unfriendly shores was done without much mechanization.[6] Once the stations were built, the domestic chores—cooking, cleaning, and maintenance—were continued.

The results of these four undertakings, as well as those of previous polar expeditions, have shown quite clearly that men are capable of working, living, and doing worthwhile research, in spite of the exceedingly difficult climatic and social conditions, from which it must be concluded that they are capable of "acclimatizing" themselves to their new environment. It is difficult to understand fully the process of acclimatization, but changes do occur as a result of the stress and strain characteristic of the polar environment, and some of them may indeed help man to adapt successfully.

The value of polar physiology in Britain has been greatly enhanced by the continuity achieved by centralizing the work in the Division of Human Physiology of the National Institute for Medical Research. What was once mystique or folklore has become record (scientific) and is the basis of an experimental approach. The orderly stages of investigation are shown in the following examples.

In Graham Land, Butson[7] recorded that men got used to wearing the same clothes in spite of the decreasing temperature as the summer changed to autumn. This was an important observation and, if valid, could lead to an index of acclimatization. If it is accepted that men dress to achieve comfort and that this sense of comfort is an accurate indicator for comparison, we can then equate the amount of clothing worn (i.e., the insulation) with changes in the environment. Accordingly, in subsequent Antarctic parties, records of clothing worn were kept throughout their stay. The records included the environmental conditions and the work done at the time of the observation. The results have shown that in the relatively milder climate of Graham Land (Evans, unpublished) men indeed do not vary the amount of their clothing as it gets colder. But under the extremely cold conditions experienced during the T.A.E., men did vary their clothing according to the seasons; however, for periods of comparable climatic stress the men wore fewer clothes at the end of their period of exposure than at the beginning, i.e., they were better able to withstand the cold.[8]

Many problems have still to be solved—the fact that clothes wear out, or become dirty and lose their insulation. The insulation value of a clothing ensemble varies greatly with movement or fit, and the value of an individual layer of insulation depends on its relation to other layers. Nonetheless, Butson's report has led to a new approach to the problem of acclimatization.

An observation of an entirely different nature proved to be the beginning of a useful line of work on human nutrition. It originated from

watching huskies eating human feces. It had been said that since explorers ate so much fat, a part of it was unabsorbed and was excreted, constituting a food supply for the dogs; but on examination of the stools it was found that there was practically no food value in them and that all the fat ingested had been absorbed.[9] This prompted a careful measurement of the nutritional intake, which showed that men while traveling consumed 5,000 calories. Even while living in the base hut and doing the everyday tasks, they took 3,000 to 4,000 calories. These requirements are so great that the ration scales had to be increased, particularly for traveling because the ordinary British sledging ration provided only about 4,100 calories. This gave an opportunity to take advantage of modern technology of food and packaging to develop a new ration.[10]

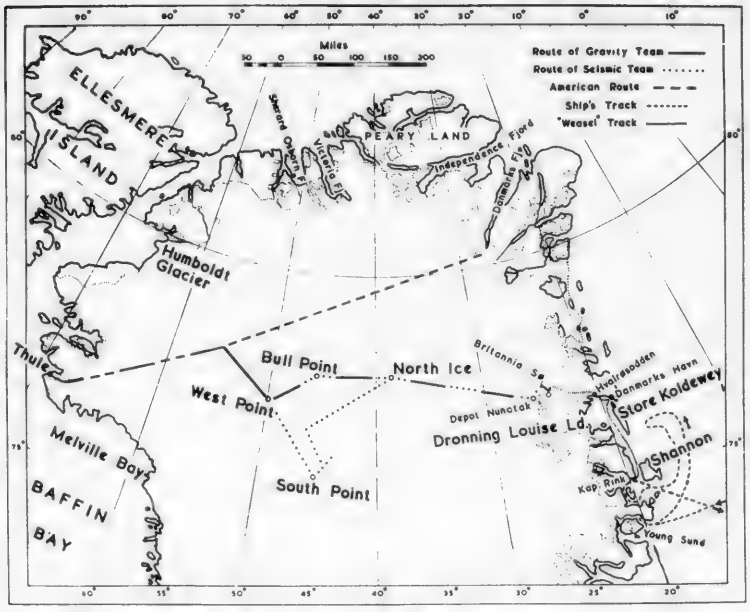

Fig. 2—Greenland, showing the site of the Base Laboratory at Britannia So and the routes of the traverse parties.

The circumstances surrounding high fat consumption have always been puzzling. The Eskimo eats an unusually large quantity of it and is said to lay it down subcutaneously, where it is supposed to help keep him warm. But careful observation during our expeditions never showed that men who were overweight had any special advantage. Members of these expeditions were also found to have a high fat intake; having confirmed that they absorbed all of it, a study of its fate was undertaken.

Results from the four dissimilar enterprises that have been followed give a fairly clear answer. Skinfold thickness (viz., subcutaneous fat) varied not as a response to cold but with changes in men's activities. Thus, in the British North Greenland Expedition, body weights tended to rise in the winter and fall in the spring and summer. This closely mirrored the physical activity, which declined during the polar night while it was at a very high level during the short summer season, in which travel was possible. On the other hand, in the first year of the T.A.E., where hard physical work continued throughout the winter, body weight changes did not correspond to the earlier predictions but fell throughout the winter, rising a little as conditions improved with the oncoming spring. At other stations, too, body weights were a good index of the changes in activity, which is determined largely by the seasons—the continuous darkness of the winter normally permits far less activity than the summer light period.

Even if the increase of subcutaneous fat were a response to cold, the amount required to increase insulation would be much larger than has been found. In abnormal exposure, with the skin cold and blood vessels constricted, subcutaneous fat would delay the loss of body heat. But normally men wearing clothes at work aim to feel comfortably warm, so that their blood vessels would be dilated, allowing warm blood to flow through the subcutaneous fat and thus its insulating value would be minimal. In fact, it is far more ergonomic to add an extra layer of clothes, such as a pullover, if one has to go out in the cold than constantly to carry excess fat.

Confirmation of these findings requires more sophisticated techniques to measure variations of energy expenditure and nutritional balance, together with the simpler records of body weight and skinfold thickness. These investigations illustrate the stepwise progression of polar studies achieved by centralization and continuity of research.

On the subject of local acclimatization, Mackworth,[11] in investigating the ability of men to work barehanded in cold climates, devised a test to demonstrate changes in finger touch sensitivity. The apparatus consists of two straightedges mounted in a V. The subject slides a finger along the diverging edges until he can discriminate the two edges distinctly.

The distance between them constitutes an index of tactile sensitivity. This technique, very suitable for field work, was used on F.I.D.S. It was found[12] that the fingertips of new arrivals in the Antarctic were twice as numb as those of second year men under identical cold conditions, but within six weeks there was little difference between the two groups: There had been a measurable adaptation of tactile sense in the cold. The stage is now set to investigate the nature of this adaptation.

Some research depends on observations recorded by the men themselves. Interesting studies on sleep have been made by means of sleep records. The continual summer daylight and winter darkness in high latitudes was thought to disrupt the ordinary diurnal rhythm of sleep, but from observations on these polar expeditions it is clear that the dominant factors are not those of daylight and darkness but rather of social pressures and the nature of the work that is being done.

On the British North Greenland Expedition there was a minimum of social organization, and at some periods the men could sleep when and for as long as they wished, whereas on the permanent F.I.D.S. bases there was greater social discipline. In Greenland, during the winter, men took their sleep at any time throughout the 24 hours, while in Graham Land they slept at the more usual hours between 10 p.m. and 8 a.m. It was found, in both circumstances, that the average sleep per night was about eight hours (Greenland 7.9 hours; F.I.D.S., 8.2 hours), showing that this may well approximate to the biological demand.[13] For medical research the complete cooperation of subjects was essential, and extra efforts to achieve this have been well worth while. In some ways, the arrival of the physiologist was welcomed by his subjects as a relief from boredom. The making of observations was eased by the fact that the subjects themselves are scientists and are interested in increasing the scope of the scientific results. It has been possible to gather unique data over long periods of time because the men were "captive" and often under one roof. Curiously, in civilization, one finds very few data over extended periods for comparison with the polar information; for example, little is known of the normal seasonal variations in body weight, metabolic rate, and skinfold thickness.

It became apparent that many of our results were not dramatic, even though the cold environment, total darkness, and isolation were. The reason is that the brunt of the harsh environment is taken by clothes, shelter, and heating, leaving only a fraction of real exposure. How precisely to assess this environmental stress is occupying our interest at present; we may find that the properly dressed polar traveler experiences less exposure than, say, the optimistic civilian in Britain. Here, too, there is no knowledge of a man's precise exposure in temperate climates, and observations begun in the Antarctic will have to be extended to Britain.

The members of polar expeditions work extremely hard under conditions which are considerably worse than those contemplated by any industry planning Arctic operations. Thus, observations made on these men can lead to a real knowledge of human capabilities. It is of interest, therefore, to compare the two situations. Apart from the obvious differences in personnel and organization, there are considerable contrasts in motivation between the members of a polar expedition and workers in an industrial project. Social behavior in his peculiar environment is largely governed by a man's motivation. Members of expeditions are, by and large, keen to take part in an adventure, as well as in forwarding the progress of knowledge; their pay is not commensurate with their discomforts and may be merely nominal. In industry, the main motivation must be money, but it is almost as important to convince the worker that he is taking part in a worthwhile and exciting venture.

Contrary to popular belief, the morale of members of expeditions does not suffer as discomforts increase, provided, of course, that leadership is good and that the men know what they are doing.[14] There seems to be some evidence that increasing the creature comforts without lessening the isolation brings with it an increase of social problems. Until relatively normal conditions of settlement can be established in high-altitude outposts, it is most important to engender a spirit of pioneering rather than to try to improve conditions superficially.

The important lessons that can be learned from small expeditions—which are really microcosms of more ambitious projects—are that man can work and live for long periods under unusual climatic and social stresses. Given the experience and the right type of leadership, he can learn to face the conditions the very thought of which makes those at home shudder. With carefully chosen, but not excessive, normal clothing and with shelters which are simple but built on scientific lines, life can continue normally under conditions which would, in theory, appear impossible.

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GUIDE FOR INDUSTRIAL IMMUNIZATION PROGRAMS

The following statement, prepared by the Committee on Industrial Health Emergencies of the Council on Industrial Health, has been approved by the Board of Trustees of the American Medical Association. — B. DIXON HOLLAND, M.D., Secretary, Council on Industrial Health.

Health maintenance is primarily the responsibility of the individual person; however, the employer has an obligation to provide a safe work environment for his employees, and he has a valid interest in the prevention of loss of work time and of work efficiency from his employees' ill health. Definitive diagnosis and therapy of nonoccupational injury or illness is not a responsibility of the employer; but he may provide certain preventive health measures in a given situation where the employee, the employer, and the community stand to benefit. While it is impossible to foresee every situation which might occur locally where an employer might properly make immunization procedures available to his employees, the following principles are offered as a guide.

1. Toward fulfillment of his obligation to provide a safe work environment, or to take appropriate precautionary measures, an employer should provide immunization procedures to employees who, by reason of their occupation or job assignment, may be exposed to significant hazards against which immunization procedures are available.

2. In keeping with his legitimate right to operate efficiently and profitably in a free enterprise system, with his responsibility to the community, and in demonstration of his good corporate citizenship and concern over his employees' health, an employer may provide immunization procedures in the face of an impending epidemic which threatens to disable so large a proportion of his employees as to interfere materially with operations and against which immunization procedures could not be applied by community health resources in a short enough period of time to afford the optimum protection. The component medical society's approval of company immunization programs conducted under these circumstances should be sought, and to the extent feasible and practicable local physicians should be afforded an opportunity to participate in them.

3. Additionally, an employer may wish to participate in community-wide immunization programs at the request of and in cooperation with a local medical society and community health agencies.

Committee members are Norvin C. Kiefer, M.D., Chairman, New York; Cortez F. Enloe Jr., M.D., New York; Allan J. Fleming, M.D., Wilmington, Del.; John N. Gallivan, M.D., East Hartford, Conn.; James H. Lade, M.D., Albany, N. Y.; Eugene Walsh, M.D., Chicago; and Lee N. Hames, Secretary, Chicago.

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Clothing for Cold Conditions

L. H. Turl, M.A., Ph.D., Toronto, Ont.

THE RELATIONSHIP between clothing, climate, and comfort has been a matter of both general and scientific interest over the centuries, and a brief treatment of the historical approach will be found in an admirable general review by Kenchington.[1] Considerable impetus was given to scientific investigations in this field by the military problems of World War II, and much of the knowledge accumulated during this period has since been published.[2, 3, 4] Extensive bibliographies will be found in all three of these works, although Newburgh's edition is now regrettably out of print. Accounts of studies carried out during and since the war are scattered through a variety of journals and reports, the latter originating chiefly in defence research agencies, such as the Ministry of Supply and the Royal Aircraft Establishment (U.K.), the U.S. Quartermaster Research and Engineering Command, Natick, Mass., the National Research Council, and the Defence Research Board of Canada. In the main, current research and development activities are pursued or sponsored by these and other defence agencies, although some active interest exists also in industrial and academic quarters.

In temperate climates the need for clothing is popularly associated with cold weather. Temperature is the primary factor popularly considered in the choice of garments to meet the prevailing climate; conditions of wind and moisture are noted also by the wise. Less commonly taken into account is the level of activity of the wearer, frequently of greater importance than climatic variables. Indeed, the most appropriate selection of garments can be made only with due regard for both activity and the duration of the exposure intended, since body heat production and reserve together determine body temperature under given conditions and duration of heat exchange with the environment.

The question of clothing for cold conditions can be examined most conveniently by treating its different aspects separately in the first instance. These are (1) the environment, (2) physiological and physical considerations, and (3) clothing materials and design. In every actual situation, of course, all of these aspects must be recognized simultaneously in the adoption of any solution to the clothing problem.

From the Defence Research Medical Laboratories, Department of National Defence.

The Environment

Cold climates are generally those in which the temperature is below 10°C (50°F). It has become customary to distinguish cold climates on the basis of the presence or absence of substantial amounts of water or water vapor, and the terms wet-cold and dry-cold are commonly associated with certain well known but roughly defined conditions. Wet-cold has been defined as the condition of temperature between approximately 50°F and 15°F, with high humidity or rain, wet snow, sleet, or fog. Dry-cold is understood to refer to conditions involving temperatures below 15°F, in which water is normally not encountered and water vapor concentrations in the atmosphere are very low. While such definitions are arbitrary, they serve to emphasize the importance of water and water vapor in the problem of keeping man in thermal balance with his environment. In addition to temperature and moisture, the most important climatic factors bearing upon the clothing problem are wind and solar radiation. In marine situations spray and salt are also of major practical importance.

Every actual climatic situation represents a combination of these factors in which each contributes to some degree. The severity of the climate will depend entirely upon the particular combination encountered. For example, low temperature and wind together constitute the most commonly recognized combination of adverse conditions, and this combination has, for some years, been described in practical terms by the "Windchill Index." This index refers to the rate of cooling of warm objects

exposed to given wind and air temperature conditions and owes its practical application chiefly to the primary importance of exposed skin area (e.g., the face) in personal comfort and welfare. An approximate formula for the calculation of the index, due to Siple and Passel,[5] is:

$$W = (9.0 + 10.9 \sqrt{V} - V)\ (33 - t_a)$$

where W = rate of cooling in kilocalories per square meter per hour
V = wind velocity (meters/sec.)
t_a = air temperature (°C).

Actual heat loss from the body cannot be estimated from the Windchill Index alone, since the efficiency of the clothing in obviating the effects of wind and air temperature is the dominating factor.

From common experience on clear and cloudy days of similar temperature and wind conditions the influence of solar radiation on personal warmth is well known. Perhaps the most striking demonstration of the importance of solar radiation, in combination with a high level of physical activity, is provided by the light clothing requirement for skiing in snow-clad valleys, when direct sunlight is augmented by reflection from the surface of the snow.

The frequencies with which particular combinations of the major climatic factors are encountered are significant in determining the importance to be attached to different requirements of regional climatic environments. Demands for clothing are often based on unrealistic extreme conditions of climate, in which it is presumed that different variables assume their severest extreme concurrently. While each of the major climatic variables reaches extremes on occasion, rarely does this occur for more than one variable simultaneously. For example, in northern Canada, while temperatures are often below −60°F, extreme wind conditions are not experienced at the same time. The severity of the climate for human beings in such cases is less than that of windy conditions at much higher temperatures found at lower latitudes. The daily or monthly mean values and ranges of meteorological variables normally available are not of great value to the climatic physiologist; both the duration and the modes of combination of climatic variables (i.e., frequency data) are required to estimate their combined effect. Although the importance of combined frequency data has been recognized, relatively few are yet available.

The notion that the more important meteorological measurements (e.g., temperature, humidity, wind speed, solar radiation) might be combined into a single military index as a guide to clothing requirements has obviously attractive simplicity. Several approaches have been suggested for this purpose, but none has successfully met the full requirement, particularly in relation to cold climates, where the little-understood effects of humidity appear to play a vital role. Burton[6] has shown that a thermal wind-decrement can be subtracted from the prevailing air temperature and a solar radiation increment added to reach an equivalent still-air temperature useful in the estimation of clothing requirements. Either correction may be as great as 35°F. He concludes, however, that the metabolic rate of the man is a dominant factor which cannot be included in such corrections to air temperature and that separate charts or tables dependent upon activity are essential.

Physiological and Physical Aspects

Of importance equal to or greater than the environment in the clothing problem is the physiological character of man, through the physical demands which it imposes upon both the materials and the design of clothing ensembles. Because of the wide variation possible in the heat and water output of the body, maximum adaptability of clothing is a prerequisite and is a problem of particular difficulty when the severity of the climate is such as to render protection imperative.

The regulation of body temperature requires the dissipation of heat at approximately the same rate as it is produced. The rate of heat production depends upon the conversion of the chemical energy of food into the kinetic energy of muscular activity, and varies over a wide range. At rest, heat production is of the order of 50 kilocalories per hour per square meter of body surface, and may reach levels several times as great in vigorous exercise. The dissipation of this heat takes place primarily through the surface tissues of the body by conduction and evaporation. Essentially evaporative heat losses of a relatively less variable nature take place through the respiratory tract.

By conductive processes and blood circulation heat is transferred from within the body to the surface. Two physiological thermoregulatory mechanisms influence the thermal exchange with the environment. The first of these functions through the dilation or constriction of peripheral blood vessels to vary the flow of blood to the surface tissues. This mechanism, which may be readily observed in skin temperature fluctuations, affords a major thermostatic control capable of varying heat release by a factor of 5 or 6. Our capacity to achieve

thermal comfort with different amounts of clothing under similar climatic conditions, and to remain comfortable at different levels of activity under the same clothing and ambient conditions, is a consequence of this mechanism. Within such limits clothing constitutes no physiological problem.

The second mechanism for the regulation of heat dissipation by the body is sweating. Comparatively large amounts of heat are involved in the evaporation of water, 1 gm of water requiring approximately 0.6 kilocalorie of heat to pass into the vapor phase. Evaporation takes place continuously from the human body, both from the respiratory tract and from the skin, unless ambient conditions of temperature and vapor pressure are such as to prevent it (e.g., in tropical jungle conditions). At rest, 40% to 50% of the evaporative heat loss takes place through respiration; the remainder occurs at the skin surface. The total resting evaporative loss of water from the average adult amounts to about 35 gm per hour and represents a heat loss of about 21 kilocalories, or one-quarter of the total heat loss. Physical activity may increase the volume of water lost by perspiration to more than 10 times the level observed at rest. Evaporative heat loss may therefore be increased to about three times the total resting heat production, a most important physiological feature in body temperature regulation. Obviously, should clothing interfere with the evaporation of sweat and the escape of water vapor to the ambient atmosphere, the primary physiological means of thermoregulation will be impaired. It is particularly worth noting that only when the evaporation of sweat takes place on the skin will the efficiency of the mechanism be at its highest level.

In addition to evaporative losses, heat dissipation from the body takes place by conduction, convection, and radiation. The conduction of heat through clothing fabrics is a slow process, since these materials normally contain between 60% and 80% of entrapped air. Thermal conduction by the fibers contributes very little, and the thickness of the fabric may under still-air conditions be taken as an index of its thermal insulation. Convective effects include heat losses due to air movement, whether by temperature (density) gradients or by wind. Ventilation within or through clothing layers may change radically the heat losses from the body, a fact well known to those exposed to cold winds in inadequately windproof garments. Controllable ventilation within clothing assemblies constitutes a most important feature in accommodating a wider range of climatic conditions and levels of activity. For the clothed man, radiation of body heat is probably the least important of the physical mechanisms operative in heat transfer.[7]

Heat losses from exposed areas of the body can be substantial in cold weather, and exposure of the hands and head can be employed as an aid to maintaining thermal balance with the environment. A recent experimental study of heat losses from the head by Burton[8] has shown that at temperatures as high as 25°F a man may lose half of his resting heat production and at 5°F three-quarters of it through this route alone, without being aware of it at the time. For a clothed man with uncovered head, the nonevaporative heat loss H is related to the environmental air temperature t (°C) by the expression

$$H = 285 - 7.55t \text{ (kilocal/m}^2\text{/hr)}.$$

The importance of covering the head when inactive in cold weather and of increasing body heat loss in periods of exercise by removing the headgear is probably not fully appreciated by many.

With the exception of exposed areas of the body, which in cold climates are normally a very small proportion of the whole, comfort may be regarded as dependent upon the subclothing mircoclimate. This microclimate is governed by body heat and water vapor production, the properties of the entire clothing assembly and the nature of the environmental climatic conditions. The clothing serves as a barrier between the micro- and macroclimates, and must regulate the outward flow of heat and vapor in such a manner as to maintain subclothing conditions within a range compatible with the comfort and efficiency of the wearer. The relatively critical nature of subclothing conditions is indicated in recent Antarctic studies by Adam,[9] from which it was concluded that subjective sensations described as cool, comfortable, and warm correspond to microclimate temperatures differing by only 2°C (3.6°F) for the upper body and 3° (5.4°F) for the lower body and legs.

The various avenues of heat loss discussed above are interdependent to a considerable extent on actual clothing assemblies. The interrelationships among them are very imperfectly understood but may be resolved by further experimental investigation of the complex of factors involved in the behavior of clothing on live subjects exposed to controlled climatic conditions. Such studies are difficult, both in instrumentation and in analysis, but are essential in establishing a quantitative basis for further progress in the improvement of clothing.

Clothing Materials and Design

In both dry- and wet-cold environments temperature and moisture are obviously the primary factors to be considered, particularly in relation to the heat exchange involved in the evaporation of water. A rather careful balance is necessary between the evaporative heat losses required by the body and water vapor transfer through the clothing as a whole; this transfer depends upon the local vapor pressures and temperatures within the clothing. The intra-clothing conditions are also much influenced by ventilation, and are therefore a consequence of garment design and use, as well as of the properties of the materials involved. With certain frequently encountered combinations of personal activity and environmental conditions, it may not be possible for evaporation and vapor escape to keep pace with sweat production, and accumulation of moisture within the clothing results. A similar situation may arise when water from environmental sources is accumulated in the clothing. The large amount of heat required for the evaporation of water attaches extreme importance to this situation, since an enormous demand for heat from the body may result later when activity is much reduced. These effects of moisture upon the heat exchange are, of course, a consequence of the requirement for thermal protection, and arise in large measure from the nature of the clothing itself, in that clothing offers both resistance to vapor escape and a reservoir for moisture.

Three fundamental principles must be recognized in the design of clothing for protection against cold:[10]

1. The diffusion of moisture (water vapor) away from the body surface cannot be prevented without serious interference with normal physiological temperature regulation.
2. Internal moisture, from the production of sweat by the body, should not be allowed to accumulate within the clothing.
3. The accumulation in clothing of moisture from external sources should be prevented.

Recognition of the first two of these requirements is especially important when the body heat output rises to a level which cannot be accommodated by adjustment of the clothing, because under these circumstances the sweat mechanism is activated in an effort to increase body heat loss.

Personnel engaged in tasks requiring a relatively constant level of activity in a constant environment are least likely to vary sweat production rate, and by proper initial choice of clothing can usually achieve comfortable conditions without risk of contravening the second principle. Since emotional stress can result in sweat production, the possibility of variation in moisture output exists even though thermal output and environmental conditions are both reasonably constant.

The heat losses resulting from the accumulation in clothing of water from any source can be large, particularly in windy conditions, because of increased thermal conductivity and evaporation. The thermal conductivity of water is of the order of 20 times that of dry fabric, and so the thermal insulation afforded by the clothing may be reduced to a fraction of its original value as a consequence of its becoming saturated with water. In the presence of wind the temperature of exposed wet clothing will fall to approximately the wet-bulb temperature so long as evaporation continues. The imbibition of water by the clothing thus creates a potential thermal "sink" of very large capacity. For example, a clothing assembly weighing 10 lbs. when dry would, if saturated with water, constitute a means of dissipating heat of the order of 2,000 kilocalories, an amount equivalent to many hours of heat production by the human body. In cold weather a large portion of the heat required by the evaporation of this water from saturated clothing would be taken from the body. Continuous exposure to rain or spray would serve to maintain the flow of heat from the body at a rate governed by the temperature of the wet clothing and the temperature of the skin and underlying tissues. Depending upon the degree of contact between the clothing and the body, this would approach the condition of immersion in cold water (at the wet clothing temperature) in which human endurance times are known to be short.

Two general types of solution have been attempted for the wet-cold clothing problem. First is the development of clothing freely permeable to water vapor but possessing the property of waterproofness in the outer layer. While this type of clothing is ideal from the theoretical viewpoint, completely waterproof materials providing a high degree of vapor permeability have not yet been produced. For limited exposure, currently available water-repellent fabrics of common types meet the civilian requirement reasonably well. Military demands for protection under conditions ranging up to immersion in cold water have been met with some success by fabrics of special construction, such as the Ventile fabrics, and by the production of waterproof coatings having a considerable degree of permeability to water vapor. In this respect, recently developed

synthetic coating materials appear promising for clothing use. The use of two layers of tightly woven fabric rather than one to form the external barrier has also been found to offer advantages in resisting the penetration of water. Woodcock and co-workers[11] have recently suggested that two relatively air-permeable fabric layers with a space between them may be more effective as a windbreak than a single outer layer of low air-permeability. Considerable practical advantage might be found in combining wind- and water-resistance in such a double outer layer.

The second general type of clothing for wet-cold employs the "vapor barrier" principle. This approach virtually abandons the advantage of permeability to water vapor but offers thermal insulation which cannot be destroyed by moisture from any source. Synthetic foam-type sheet materials have been employed in experimental clothing of this type. While moisture-proof thermal insulation is achieved together with "built-in" buoyancy for marine service, ventilation within the assembly becomes the sole means of accommodating the varying requirement for heat exchange. In situations in which metabolic rate remains relatively constant, adjustments can usually be made to achieve a satisfactory degree of comfort. The limitations of the clothing of this kind produced thus far are rather serious, and militate against its adoption for general use. Footgear employing the vapor barrier principle has proved very successful in military service in wet- and dry-cold operations.

Marine experience has placed greatest emphasis on the need to exclude cold sea water, spray, and rain from the clothing. The familiar "oil skins" (still highly regarded in many branches of maritime service) have provided a useful practical approach to meet this need. Unfortunately, the escape of water vapor from the body is greatly impeded by these garments, particularly if their design is such as to exclude water successfully. Depending upon ambient conditions and the activity of the wearer, this frequently leads to saturation of the clothing by accumulated perspiration. This disadvantage for the active wearer is mitigated somewhat by the fact that impermeability also reduces after-exercise chill by preventing the evaporation of water in the underlying wet clothing. In practice, the hazard of chilling by external cold water appears to take precedence over the discomfort associated with the impedance of vapor escape from the skin.

The clothing requirements for dry cold either in the natural environment or in man-made situations such as cold storage areas, are less difficult than those for wet-cold, because water from external sources is not encountered. With the exceptions that less protection against external moisture and greater thermal insulation are required, the solution of the wet-cold problem applies also to dry-cold conditions. The primary problem is to achieve adequate wind resistance and sufficient thermal insulation while avoiding the accumulation of sweat in the clothing. The demands of a varying level of activity remain serious, because moisture from internal sources constitutes the same hazard as in the wet-cold climate. Adjustability must therefore be a primary feature of the ensemble, whether achieved by the use of variable closures or the removal of layers or by other means.

Conclusions

It might be expected that after centuries of experience with clothing sufficient knowledge should have been accumulated to enable confident recommendations to be made for any climatic conditions. Knowledge we have, but it is highly empirical, and neither lends itself to extrapolation nor provides a basis for the utilization of new materials with which no experience is available. Many factors, complex in themselves and in their interactions, require much further study before a sound scientific position can be reached. Certain general principles are clear, nevertheless, and afford the best presently available guidance in the choice and use of clothing to meet the requirements of cold conditions.

1. Clothing ensembles should be as permeable as possible to water vapor. All textile fabrics other than coated materials are permeable, as are most types of leather to a lesser degree. The permeability of coated fabrics is governed entirely by the coating material. No freely permeable coated fabrics have yet been produced, although recent developments show promise.

2. In cold climates where wind is a factor, the highest degree of wind resistance is desirable in the outer clothing layer or layers.

3. In cold climates where (wet) precipitation is encountered the highest degree of water repellency or penetration resistance is desirable in the outer layer.

4. In clothing ensembles for general cold weather use, maximum accommodation of varying climatic conditions and levels of activity is essential. Design features affording ventilation within the assembly, as well as constructional features to minimize the adverse effects of absorbed perspiration (e.g., the "string"

vest), are highly desirable to permit adjustment of the rate of heat loss as required.

5. Weight and stiffness of assemblies should be kept to a minimum. With adequately wind- and water-resistant outer fabrics a minimum of bulk and weight of thermal insulation is required beneath.

6. Clothing should be used with intelligence, to avoid the onset of conditions within it which reduce or destroy its effectiveness. Varying levels of activity (and particularly high sweating rates) should be anticipated where possible, and minor sacrifices in comfort made if necessary to secure continued maximum performance of the clothing.

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Human Tolerance to Cold

Loren D. Carlson, Ph.D., Seattle, Wash.

SOME GENERAL evaluation of man's tolerance to cold may be gained from the temperatures at which he lives, albeit well clothed; from the experiences of expeditions into cold regions; from temperatures at which poorly clad people live; and from experimental work on human subjects during controlled cold exposure.

The Eskimo, the Arctic Indian, and the Lapp have long been symbols of man's ability to survive at low temperatures. Living in areas where winter temperatures drop to –40°F for long periods with extremes as low as –90°F, these ethnic groups were a marvel to early explorers.

That the Eskimo is not unique in his ability to survive at low temperatures is evidenced by the reports of many expeditions. Charles F. Hall[1] lived with the Eskimos along the Northwest Passage route for four years. He lived Eskimo style and went on many sledge journeys lasting as long as three months. The temperature at the start of one two-month journey made with low provisions was –80°F. Greely[2] reported sledge trips for 10 days with a mean temperature of –42°F and for 60 days with the temperature frequently from –31° to –49°F. In Scott's[3] first expedition, a 59-day trip was made by 12 men manhauling four sledges at temperatures as low as –40°F. Bowers, Wilson, and Cherry-Gerrard[4] made a five-week midwinter journey for penguin eggs, manhauling two sledges and camping in a tent, with temperatures mainly at –60°F and as low as –77.5°F.

Clothing and shelter are the major reasons for survival at these extremely low temperatures. The clothing required as insulation varies with the metabolism of the individual, and the actual thickness required over any area is determined by the geometry of the part.[5] Protection of the trunk or of the whole body as in a sleeping bag is far simpler than protection of the hands and feet. Thus the man living in extreme cold may solve his problem of heat balance at rest with heavy insulation and find it possible to maintain his heat balance while active with less insulation. Even the best clothing fails to protect adequately the face or extremities.

Charles Darwin's[6] description of the people of Tierra del Fuego and studies of the Australian aborigine establish the existence of men living poorly clad in environments that are cool for long periods and cold in winter. The temperature in Tierra del Fuego is 50°F in summer and 33°F in winter with days as cold as 12°F. Darwin marveled "in this wretched climate subject to such extreme cold, is it not most wonderful that human beings should be able to exist unclothed and without shelter."

Experiments on man have included studies of people who live in extreme temperatures as well as subjects from temperate climates experimentally exposed clothed to very low temperatures (–40°F) and unclothed to cool environments (50°F). A special instance of marked resistance to cold is evidenced by English channel swimmers[7] and those swimming in the Straits of Juan de Fuca.[8]

Man can exist and function in cold environment, but his limits are undefined and the extent to which he adapts cannot be stated clearly owing to difficulties in definition and the variety of criteria used to demonstrate this ability. The criteria for functional acclimatization to cold environments vary from manual performance tests to rather elaborate metabolic balance studies involving determinations of thyroid and adrenal cortical function on the one hand and clinical assessment of health status on the other.

Two types of exposure are clearly defined: exposure clothed in an extremely cold environment and exposure thinly clad in a moderately cold environment. It is unlikely that in either case a steady state obtains for any period, since the large heat capacity of man's body and his periodic activity lead to

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shifts of heat production and loss when a continuous negative heat load is applied. Glaser[9] has suggested that heavy exercise may interfere with cold acclimatization as a result of the large heat input. While it is commonly accepted that the blood vessels of the hands and feet constrict in the cold, it has been shown that the vasoconstriction does not occur if the body is in positive heat balance. Similarly, the endocrine response to cold stress may be different with periodic cooling of the body than with prolonged cooling, or with sudden cold exposure rather than slow cooling. During rest or sleep, a gradual cooling may occur, involving both peripheral and central portions of the body. Other exposures involve extreme cold to face and hands and gradual cooling of the body.

While Scholander[10, 11] and his associates emphasize the ethnic or adaptive relationships in the ability of the Australian aborigine to sleep in the cold while his body temperature slowly falls, they have not tested the response of Caucasians living with the natives for one or two years. Indeed, the aborigine in the tropical part of Australia does not show the type of response the central aborigine does.[12] LeBlanc[13] demonstrated an effect similar to that observed in the aborigines in his study of white males. LeBlanc considers this finding a contradiction of the hypothesis advanced by Carlson and his co-workers,[14] although it may be an extension of it.

The same type of response has been observed by Rennie[15] and by Elsner and his co-workers[16] in resting white male subjects and in the Indians of Alaska. Thus, as has been repeatedly emphasized by workers in this field, the ability of the individual to draw from body stores appears to varying degrees, and some of the variation is apparently attributable to the differing degrees of exposure and to the nature of the cold stimulus applied to elicit the response. A matter of great interest is the mechanism whereby this change in response occurs, whether it be central or peripheral.

A second type of functional response found in those exposed to cold is a change in circulation to the hands and feet. This change maintains the extremities at a temperature higher than expected with a given cold exposure. Balke and his co-workers[17] first demonstrated this response, and its occurrence has been subsequently confirmed by Carlson and his co-workers,[14] by Rennie,[15] by Elsner,[18] and by others. Brown and his co-workers[19-21] found highly developed responses of this type in the Eskimo, and Mackworth[22] and Massey[23] elucidated the changes in manual dexterity and tactile response resulting from this circulatory change. The mechanism of this response is still unexplained. Carlson[14] suggested that a heat-exchanger mechanism similar to that described by Scholander[24] might be involved and presented some evidence for it. Wood's[25] observations on venous tone would also support this suggestion. Although a varying increase in metabolism has been demonstrated, this increase is not sufficient to explain the phenomenon if our present understanding of the interrelationships of the core and shell of the body is correct. A shift in centers of high metabolic rate, however, may be worth investigation. There is some evidence that the response is linked with the increase in physical fitness that invariably accompanies cold exposure. There are undoubtedly ethnic differences with respect to this response as illustrated in the Negro.

The increase in metabolism with exposure to cold demonstrable in the white rat has no parallel in experiments in man, although it is established that if man is exposed to cold his food intake will increase. Similarly, the metabolic and endocrine interrelationships seen in the rat have not been demonstrated in man, principally because obtaining sufficient cold exposure is a difficult problem. DuBois and his co-workers[26] indicated that chemical regulation is present in some women and by deduction from their data, state that it is present to a lesser degree in both men and women. Thyroid activity did not increase in persons living in a cold country who were exposed particularly to cold, but Bass[27] has reported an increase in thyroid activity when thinly clad subjects were exposed to 50°F. Butson[28] noted an enhanced response to epinephrine in men living and working in the Antarctic.

While the threads of evidence concerning man's acclimatization to cold seem separate and unrelated, this disconnectedness results partly from the lack of control of experimental method and criteria. It is apparent that changes occur that may be classified as acclimatization. Studies in the field seem to yield most significant results. The approach of Scholander has the virtue of applying a similar technique to a variety of people with different temperature histories. Man's endeavors in the cold climates begin with his motivation, but are made possible by accustomation and acclimatization.

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1960 NATIONAL HEALTH FORUM

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New guidelines for programs to promote the positive health of older people will be sought by approximately 600 invited authorities representing health and medicine, education, religion, government, social welfare, industry and labor. They will discuss reports on current and contemplated research on the aging and exchange information on programs for the aging now under way in this country and abroad.

Chairman of the Forum is Edward L. Bortz, M.D., chief of medical service at Lankenau Hospital, Philadelphia. The Forum is sponsored by the National Health Council. For further information, write: Philip E. Ryan, Executive Director, National Health Council, 1790 Broadway, New York 19, N.Y.

Industrial Back Prevention

Chas. Rombold, M.D., Wichita, Kan.

INJURIES to the low back are so common in industry that the impairment has come to be called the "industrial back." But both the frequency and the severity of low back injuries to employees can be greatly reduced by a comprehensive program of prevention of "industrial back." One such program, the effects of which during an eight-year period were measured against company experience of the eight years preceding its inception, revealed the following impressive results: 70% fewer lost-time injuries, 93% fewer days of work lost, 95% fewer days of work lost per reported injury, and 75% fewer days of work lost for each lost-time injury. Whereas 1 of 10 reported cases resulted in litigation in the base period, there was no litigation in 56 reported cases in the program period.

This industrial back program, instituted by a utility producing and distributing electric power to homes and industries in a mid-Central state, was based on procedural changes in three categories of employee relations activities:

1. Employment procedures: The company would hire only those applicants whose low backs were thought to be competent for heavy labor.
2. Safety procedures: The company would eliminate as far as possible the causes of low back injuries.
3. Treatment procedures: The company would treat low back injuries decisively when they did occur.

Employment Procedures

None of the men already employed at the inauguration of the program were reexamined, nor was their status changed in any way. The history and physical examination which previously had been accomplished for all job applicants was unchanged, except that an x-ray study was made of the low back.

The applicant was x-rayed in the same city where he was examined when such facilities were available. The x-ray films requested were a 14 × 17 inch anterior-posterior view demonstrating the area from the hip joints upward, a lateral view of the same area, a spot lateral of the lumbosacral area, and a 45 degree angle view. The x-ray films were not read by the local examining physician, however, but were sent to the consulting orthopedist at company headquarters, who then made a report directly to the company personnel department. The interpretation of the films by an orthopedist, rather than by a general surgeon or by a roentgenologist, was considered to be an essential feature of the program. The use of a single orthopedist for this function provided a single standard of evaluation for the component of the employment procedure.

Certain changes in the lower spine were considered to be incompatible with heavy labor: congenital defects, such as spondylolysis or spondylolisthesis, and transitional vertebrae; degenerative changes, such as significant narrowing of an intervertebral disc (particularly if accompanied by productive changes); active disease processes; and evidence of previous injury or surgery. Applicants with any of these changes were rejected. Frequently a combination of other structural variations, such as a very acute lumbosacral angle associated with asymmetrical facets, was also the basis for rejection of an applicant. There were many cases which were borderline and which could have fallen into the classification of "probably competent" or "probably incompetent." However, the company requested that only one of two evaluations be made from the x-ray films—either competent or incompetent—and that any conditionally qualified spine be classified as incompetent. If it developed during the employment process that the applicant possessed special skills or that he was to be employed for a particular job, then the personnel department assumed responsibility for placing him in a position where his duties could be restricted to the estimated competence of his back.

The roentgenograms, by arrangement with

From the Department of Orthopedics, The Wichita Clinic.

the x-ray laboratories in the several cities involved, became the property of the company and were filed in a central depository.

Thus by means of a short personal history of low back symptoms, a standard examination of the low back by the company's examining physicians, and standard roentgenograms of the low back interpreted by an orthopedist, an effort was made to employ only workers whose low backs were thought to be competent for heavy labor. By the end of the eighth year, when this study was terminated, approximately 49.1% of the 664 laborers then employed by the company had been selected by this process as part of the usual employment procedure.

Table I presents a summary of the roentgenographic findings among 1,000 consecutive applicants for work in the company. The second 1,000 were chosen for the tabulation because by that time the method of reporting readings had become standardized and stable. This Table does not present an exact or complete listing of defects in the lumbosacral area; rather, it lists those roentgenographic findings upon which the author based his decision of inadequacy of a laborer's spine. Such findings occurred 810 times among 660 applicants and were not observed among the remaining 340 in a total of 1,000 applicants for work.

Table I—Roentgenographic Findings in the Low Back Among 1,000 Consecutive Applicants for Work in a Public Utility Company

Occurrence of Conditions that Served as a Basis of the Judgment: Incompetent for Heavy Labor

Number of Applicants with These Conditions			660
Specific Conditions			
Narrow intervertebral discs		340	
Lumbar 5, sacral 1	323		
Lumbar 4, lumbar 5	9		
Multiple	8		
Acute lumbosacral angle		149	
Spondylolysis		71	
Transitional vertebra*		56	
Spina bifida†		52	
Scoliosis		50	
Marginal lipping		33	
Residual vertebral osteochondrosis		29	
Anterior or posterior displacement without arch defect		10	
Residual fracture		7	
Schmorl node		4	
Hip pathology		4	
Radiopaque material in spinal canal		2	
Marie-Strümpell arthritis		2	
Hemivertebra		1	
Spondylolisthesis			
Total number of conditions		810	
Number of applicants without these conditions			340
Total number of applicants in the series			1,000

*The narrow intervertebral disc which is usually associated with transitional vertebra was not included in the "Narrow intervertebral discs" category. If the transitional vertebra was fused on either side, it was not recorded as "Transitional."

†Only those involving at least one-half of the lamina of sacral 1 or involving sacral 1 and sacral 2 were noted. No spina bifida in the lumbar area was found.

On the basis of the criteria described, 20.3% of the applicants were rejected. The total cost to the company of all of the roentgenographic examinations and interpretations was about $16,000. It is believed that more than this sum was saved alone by the rejection of a limited number of applicants with only three of the various kinds of abnormality that constituted a basis of rejection: Marie-Strümpell arthritis, third to fourth degree narrowing of an intervertebral disc, and previous myelography. In fact, the two manifestly dishonest applicants who had denied back complaint in their preemployment interviews, but whose spine x-rays demonstrated Marie-Strümpell spondylitis, could easily have cost the company more than $16,000 in workmen's compensation awards alone. In this study, however, it was apparent that the x-ray examination of work applicants' backs could not have been the total cause for the immediate and dramatic drop in the severity of the industrial backs noted at the inception of the program.

Prevention Procedures

The program of prevention* included (1) analysis of faulty work habits, (2) additional new mechanization procedures, (3) indoctrination of supervisory personnel with the concept that they were the wardens of their crewmen's backs, and (4) education of supervisory personnel in detection and correction of faulty work habits.

Work Habits—The supervisors' reports of all the back injuries in the base period were studied to determine the mechanisms of the injuries. Usually the reports described the incident in some detail, but almost invariably they failed to describe accurately the back mechanics involved. In order to tabulate the mechanics of the injuries sustained, the author attempted to portray the incident in his imagination and then to deduce the mechanism causing the trauma. Any injury resulting from a heavy lift was classified as "Lift," while one that was a result of lifting a light object or that occurred with an inconsequential movement such as rota-

*Mr. Paul Jones, Safety Director of the company, not only initiated the planning from which this program developed but also took a very active part in this second phase.

Table II—Classification of Accident Causes

Work Habits Subject to Correction (69)					Accidents Not Avoidable (13)		Total (82)
Lift	Unguarded	Pull	Push	Carry	Contusion	Fall	
22	32	9	3	3	6	7	82

tion, flexion, or reaching was classified as "Unguarded." The other classifications in Table II are self-explanatory.

The character of the labor that these men performed as linemen and construction workers presumably could have made them far more liable to dramatic accidents than to minor stresses. But of all the reported accidents, there were only two falls that resulted in significant time loss. The safety engineer and the company physician observing crewmen at work noted the constantly recurring and unnecessary low back strains. Each faulty use of the low back provided a potential source of injury. Further, it was found that each of these faulty work habits was practiced inadvertently by most of the laboring crew. Table II reveals that almost 85% of the reported incidents resulted from such practices, suggesting that prevention efforts along this line could be effective.

Mechanization—With respect to the adoption of added mechanization procedures, it should be pointed out that prior to the introduction of this program the company had embarked on a plan of mechanization which was part of an effort to increase operating efficiency. Whatever value the mechanized processes probably had in eliminating back injuries was unplanned and incidental. In the program under study, however, changes in work procedures were instituted on the advice of the safety engineer and the company physician, and mechanization was expanded either through the purchase or through the improvization of machinery and equipment designed deliberately to decrease the factor of low back strain.

Supervisory Personnel—It was obvious that the safety engineer could not personally supervise the numerous crews scattered over several hundred miles of territory. Very quickly it became evident that the crew supervisor or foreman was the key to the situation. The supervisor's position provided two of the fundamentals necessary for instruction of workers as to proper use of the back. First, the foreman was in constant observation of the crew work. Second, the foreman was close to each workman in the labor-management relationship. The supervisory force, therefore, was selected as the agency through which the safety engineer could multiply his efforts and teach proper mechanical use of the back.

Before the supervisors could be expected to function effectively, it was necessary that they be indoctrinated on a point of view entirely different from that previously held with respect to the necessity for good work habits. Virtually no importance had been placed upon the effect of faulty use of the back under normal working conditions. To instruct the supervisors in the detection and correction of faulty low back work habits, classes were formed in small groups ranging from 6 to 10 members. They were held at the company's offices on the company's time, and the supervisors were required to attend. Conducted primarily by the safety engineer with the assistance of the company physicians, each class met until the safety engineer was satisfied that the principles of detection and correction were understood and accepted by the supervisors. If the safety engineer felt uncertain of any supervisor, that person was required to attend such other classes as were deemed necessary. It was found that three to five meetings of one hour each were required to gain the supervisors' active acceptance of their responsibility and to train them in the detection and correction of faulty back use. In each of the regular safety meetings held thereafter, some part of the program was devoted to back injuries in order to reemphasize the importance of constant alertness on the part of the supervisors.

The initial approach to the supervisors was intended to indoctrinate them with their dual responsibility: to their crewmen and to the company itself. It was emphasized to each supervisor that a back injury to any one of his crew could impair that man's economic future. An injury could cost the laborer his luxuries and possibly even the necessities of life. It could affect his children as well as the workman himself. No effort was made to minimize either the economic results of a laborer's back injury or the personal aspects of an injury involving pain, discouragement, and occasionally despair. The supervisors were shown also the tremendous economic loss accruing to the company from back injuries: costs of treatment, compensation, disability settlement, retraining partially disabled workers, and making jobs for disabled workers, all in addition to the cost of interference with operations resulting from accidents and the subsequent confusion occasioned by shifting jobs and reestablishing integrated crews.

Study of the program soon revealed that teaching the supervisors to detect and correct

faulty work habits was less difficult than indoctrinating them with a sense of their wardenship of their crewmen's backs. They had the knowledge of the techniques, but they might be neglectful in utilizing them when the occasion arose. A helpful adjunct to the program was the production of a sound-synchronized film* used as both the introduction and the finale of the supervisors classes. The film was designed to dramatize the serious consequences of a worker's back injury to himself, to his family, and to the company; to provide the supervisors with the most effective teaching approach; and, most importantly, to implant in the supervisors the desire to participate actively in the prevention of back injuries.

In subsequent safety meetings efforts were made to arouse "the old college spirit" by speeches, exhibits, and citation of cases. Throughout the whole program the supervisors were encouraged to function as athletic coaches with the need to win games, to do so by training the men of their respective squads as a team, to detect and correct the faults of their crewmen, and to give them the direction and encouragement they needed to function as a team unit. It was made known to the supervisors that their rating and advancement would be greatly influenced not only by the work accomplished by their crews as in the past but also by the frequency and the severity of their crewmen's injuries, particularly back injuries.

Mass Instruction—To supplement the supervisors' approach, the company adopted an accelerated program of mass instruction for whatever value it might have. Posters, folders, and pamphlets admonishing workers to protect their backs from mechanical strain were obtained from the National Safety Council and insurance companies. The posters were placed at vantage points in dressing rooms, recreation areas, toilets, and corridors. They were changed frequently, both in location and in context, so that their effect would not be diminished by familiarity. Racks containing folders and pamphlets were placed in company trucks and in areas where workers might congregate. While in themselves the posters and folders were thought to be of minimal value, they added some status to the general effort of the supervisory personnel.

*The film strip titled. "The Man Everybody Liked," requires 15 minutes' running time and may be obtained from the Midwest Medical Research Foundation, 3241 Victor Place, Wichita 8, Kan. All of the properties required by the safety engineer to teach the supervisors' classes in the detection and correction of improper back work habits can be provided by the National Safety Council. Suitable material can be selected to conform to the peculiarities of the industry and the qualifications of the instructor.

Treatment Procedures

It should be emphasized that when the company resolved to treat low back injuries decisively when they did occur, those concerned with case handling then adopted an entirely different attitude toward this injury. Treatment during the program period varied from that in the base period not so much in the modalities provided as in the attitude with which treatment was offered and in the promptness with which it was provided.

Previously over the years, in the treatment of industrial backs, physicians had been forced into an unfortunate position in their concept of the industrial back because of a lack of understanding of all the factors involved in the syndrome. Workers with industrial low back injuries, when compared with private patients with similar conditions often had exhibited such inexplicable symptoms and findings and their course had been so atypical that their credibility had been frequently questioned.

Most of these workers were thought by physicians, and consequently by management, to be motivated by avarice. Thus, when an employee complained of his low back, both physician and management automatically developed an attitude of resistance and distrust. The employee's normal reaction to this attitude was one of resentment and vengeance. These feelings soon became more pressing to the employee than his desire to recover his health. It followed that this vicious circle of distrust and resistance on the part of the employer and the normal compensatory reactions on the part of the employee worked to the benefit of neither.

Fortunately, in the 10 years preceding the program in question, two factors were evolving concurrently which clarified the concept of the industrial back and influenced a change in the company's attitude toward this type of industrial injury. During that period, many of the symptoms and findings in these cases found explanation in the concept of the pathology of the intervertebral disc. When interpreted by this new concept, the lumbosciatic symptoms became credible, the physical findings appeared plausible, and the minimal or normal x-ray findings seemed compatible.

The second factor which gave perspective to the industrial back was the growing recognition that an employee's psychological response to an industrial injury is entirely different from the response of a self-employed worker.

The objective and experienced physician will recognize the employee response as not a willful or malevolent reaction but a response conditioned by a number of factors, such as his fear and anxiety for his future, the effect of the injury to his sense of "wholeness," a feeling of inadequancy in coping with a major problem, his understanding that there is no guilt associated with the idleness accompanying illness, his sense of dependence on his employer, his reaction to the minor and major resentments which have accumulated toward his employer during his period of employment, and his desire to avenge himself for his injury. All these factors alter an employee's response to an industrial accident in such manner that his physical symptoms and findings, in many respects, scarcely resemble those of a self-employed person.

Because of the manner in which an employee responds psychologically to trauma, and because of a new concept of low back pathology which explained the symptoms and findings, a new approach to treatment became obvious. The company management recognized that it started with a disadvantage in dealing with the employee's first complaint. The company also recognized that its first response must be one of compliance rather than resistance if it wished to avert a chain of unfavorable reactions. Consequently, the company adopted the attitude of accepting without protest or antagonism the history and findings as credible and of proceeding with treatment on the assumption that the employee wished to get well rather than to "recover."

Evaluation of the treatment component of the program is difficult because so few cases required treatment and because the effect of an attitude is difficult to measure. It could well be argued that the company's approach to treatment was naive and that the attitude of acceptance and compliance would foster industrial back injuries. It could also be pointed out that in the program period no injuries occurred that required long treatment or surgery, making possible the conclusion that the improved experience was due solely to the decreased severity of injuries rather than to the attitude of the company and its physicians after the injury had occurred. It is also possible that the type of laborers employed by the company—self-reliant, ambitious, native men—were more responsive to this attitude than would be laborers with other social backgrounds. The importance of these factors cannot be denied, although a strong impression remains in the minds of the company's physicians and the author that: (1) the prompt job grading, occasionally amounting to practically a few days of rest, and (2) the mollification of the occasional belligerent injured employee by accepting and acknowledging his complaint. Both of which were treatment factors, were strong components in achieving the program's results. If the company's approach was naive, then in this instance naivete appeared to be sound therapeusis as well as sound economics.

There was another area in which the company's altered approach to treatment was successful: its sound philosophy encouraged a patient relationship comparable to that of a private patient-physician relationship, with confidence and understanding replacing suspicion and dissonance. That relationship surely averted in some cases the chain reactions which cause demands for psychic and monetary rewards.

The routine of reporting back injuries was also revised. In the base period the supervisor reported only those injuries he thought to be significant. In the program period the supervisors were required to report *every* back injury and also to refer the laborer to a company physician for an evaluation of its severity. This placed the responsibility for treatment and work evaluation exactly where it should be—on the company physician. The change in the reporting of low back injuries obviously increased the incidence in the program period but favorably influenced the course and sequelae of these injuries. The delayed reporting of injuries which had plagued the company in the base period, was largely obviated by the revised reporting technique. With all injuries immediately reported and evaluated, it became difficult for workers to use injuries not received on the job as the cause of symptoms; and, indeed, no such attempt was disclosed.

Summary

An effective program is described for the prevention of back injuries among the field crews of a public utility company. The essential components of the program are (1) rejection of applicants with roentgenographic or other evidence of predisposition to back injury; (2) reduction of strenuous physical labor through mechanization; (3) intensive safety training for foremen, who are required then to give close attention to back injury prevention; and (4) sympathetic determination on the part of the company and its physicians to get injured workers well.

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Arsenic: Chronic Human Intoxication

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Sources of Exposure

Since arsenic is a commonly occurring impurity in many metallic ores, the greatest degree of exposure, though not necessarily intoxication, occurs among workers engaged in recovery of this valuable element incident to the smelting of lead and copper. Among the many uses of arsenic, the most frequent application of arsenic oxides or salts is in the compounding of insecticides, primarily lead arsenate.[1] Less frequently it is used as calcium arsenate and arsenite, sodium arsenite, cupric arsenite (Scheele's green), and cupric acetoarsenite (Paris green). Arsenic is used to a lesser extent in the glass industry, in dyestuffs, and at present infrequently in pharmaceuticals[2] and in the preparation of livestock dips or powders because of its insecticidal properties. In such agricultural applications, it may consist of sodium or potassium arsenite, arsenous oxide, zinc arsenate, or arsenic sulfides. Occupational exposure, however, (except to arsine) has rarely produced acute and systemic intoxication among exposed workers.[3, 4] In the few cases of systemic intoxication arising from occupational exposure, gastric symptoms, tremors, muscular cramps, and infrequent peripheral neuritides have been reported.[4, 5]

Because arsenic is a common component of this planet's crust, the weathering of the earth's surface leads to this element's presence in most soils. In soil, its concentration varies from 1 to 40 ppm, and on eventually finding its way to the sea, arsenic is found there in concentrations of 0.006 to 0.003 ppm.[6] Because of the presence of arsenic in soils and insecticides, this element has been recovered from tobacco in concentrations of 42 μg per cigarette[7] and as a residue of poorly washed produce, especially fruits.[8, 9]

Before their discontinuance in favor of antibiotic agents, arsenical antimicrobials commonly caused serious reactions. The arsphenamines, pentavalent arsenicals, Fowler's solution, de Valager's and Donovan's solution, Asiatic pills, and sodium cacodylate are so infrequently used today that reactions due to these medicaments have become quite uncommon.

Of the several forms of intoxication due to arsenic, the acute or subacute clinical manifestations are more frequently detected than those occurring in chronic cases. Most episodes of acute arsenic intoxication are caused by accidental ingestion of various arsenicals, largely because of their wide availability in insect sprays or Paris green. Occasionally arsenic salts are used today with criminal intent, though their classical use for homicidal or suicidal purposes has become less frequent. In the past, contamination of food or liquors[10] occurred frequently, as related by Kelynack and co-workers[11] in their classic report, which involved the poisoning of several thousand people.

Physiopathology

The site of action of arsenic is principally intracellular. The trivalent arsenic ion combines directly with sulfhydryl groups, which radicals are essential components of several enzyme systems, especially the pyruvateoxidase system.[12]

Fragmentation of the myelin sheath with destruction of the axis cylinder has been reported by Heyman et al.[13] They report atrophy of the nerve followed by resorption of the myelin and proliferation of the Schwann cell. These latter alterations become more prominent in cases associated with progressive exposure.

Analysis of the liver in fatal cases usually reveals a high concentration of arsenic.[14] Pathologic alterations are commonly found in this organ and are characterized by central lobular fatty infiltration in mild cases; but necrotizing hepatitis occasionally occurs and may be followed by cirrhosis.

The other visceral organs may demonstrate non specific changes because of the widespread distribution of arsenic.

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Manifestations of Chronic Intoxication in Humans

Since most of the standard medical texts deal largely with acute intoxication, this review will consider chronic intoxication. Significant intake of arsenic usually results from ingestion or parenteral injection. Respiratory intake and skin contact may occur in occupational exposures. Absorption, regardless of route, qualitatively produces the same clinical picture. Occupational exposure, however, produces mainly dermatologic changes. Gastrointestinal and neuritic alterations have been reported but rarely in the past two decades, with most reports of systemic involvement arising from occupational exposure[4] predating the contemporary literature.

General Manifestations—The gradual, insidious onset of chronic arsenic poisoning stands in vivid contrast with the dramatic, sudden, clinical appearance of acute intoxication. The early manifestations are largely subjective, consisting of vague malaise, abdominal complaints, pruritus, ill-defined weakness, fever, arthralgia, and other pains involving the extremities.

Integument—Most cases of chronic arsenic poisoning demonstrate cutaneous manifestations, these occurring one to six weeks following onset of exposure.[13] Though most iatrogenic arsenical dermatitis demonstrates extremely varying form (erythematous, morbilliform, eczematous, urticarious, or bullous lesions), arsenical pigmentations and keratoses are distinctive. Early in the course of the disease, one may observe a diffuse, brown, dry, fine, scaly, dirty-appearing desquamation over the entire body, especially the trunk and extremities. A hyperpigmentation, which may be localized or have an Addisonian distribution or a generalized spread, may give the person an unclean, deeply tanned, or even blackened appearance. The last phenomenon is especially localized at the areolae, groins, or axillary regions. The configuration of this pigmentation often is raindrop in appearance. Pigmentation of the face is rarely seen.[11] Erythematous reactions with weeping and exfoliation occurring as a result of hypersensitivity to organic arsenicals are rarely seen in chronic inorganic arsenic poisoning.

Well-known skin changes follow prolonged absorption by any route. Hyperkeratosis of the glabrous skin is characteristic, occurring especially on the soles of the feet and palms. The upper respiratory tract demonstrates signs of rhinorrhea, nasal congestion, and pharyngitis; the eyes manifest signs of irritation comparable with the nose and throat. Occasionally inflammatory changes of the deep respiratory tract occur.[13] The nails are often brittle, and the presence of a transverse white band across the fingernail (Mee's Line), while not pathognomonic, should cause one to consider the possibility of chronic arsenic poisoning. Only the most severe cases are associated with an alopecia.[15]

In occupational exposure to inorganic arsenic dusts, the most common manifestations are dermatologic. Dusts of arsenic trioxide, found particularly in smelters, dissolve in the moisture of skin folds and mucous membranes, causing inflammatory changes. As a consequence, a congested inflammation of the turbinates and nasal mucosa occurs, associated with painful conjunctivitis and a facial dermatitis characterized by edema and erythema. The stigma most frequently associated with a relatively short occupational exposure is a self-limited perforation of the nasal septum.[2, 16] With more prolonged occupational exposure, hyperkeratoses have been seen with occasional malignant alteration.[17]

Nervous System—The earliest changes reported in chronic arsenic intoxication have occurred as early as three weeks following exposure.[13] Most frequently numbness, burning, and tingling, are present, but the frequently quoted textbook description of severe muscle cramps or sharp lancinating limb pain is absent.[13] The sensory alterations are followed by motor disturbances, usually affecting mainly the distal portions of the extremities except in more severe cases. These changes are characterized by fasciculation and occasionally gross tremors with atrophy and tenderness in proportion to the degree of poisoning. As the disease progresses with prolonged exposure, disturbed vibratory and positional perception result in clinical manifestations of ataxia, incoordination, and shuffling locomotion.

Neurological examination demonstrates impairment of touch, pain, and temperature senses, although milder cases may reveal only impaired vibratory perception. The distribution of sensory involvement has been reported as "stocking-glove."[13] The patellar, Achilles, biceps, and triceps reflexes are frequently diminished, and in severer cases these may be completely abolished. At later stages of development, foot and wrist drop may be seen. The cranial nerves are involved only infrequently.[13, 18]

Gastrointestinal System—Persistent diarrhea and cachexia develop in cases of chronic poisoning with criminal intent. Otherwise, in the usual case of chronic intoxication, the changes

involving this organ system are hardly remarkable and are mainly subjective in nature.

There may be clinical hepatomegaly associated with hepatocellular fatty alteration and necrosis. Dependent upon whether diffuse or zonal necrosis has occurred, diffuse hepatic fibrosis or multiple nodular hyperplasia follows. Jaundice has appeared irregularly in cases of arsenical hepatitis.[19, 20]

Hematopoietic Organs—Depression of the bone marrow with hypoplastic, or in severer cases, aplastic anemia, may be seen.

Other Manifestations—Periorbital and ankle edema, both of a localized nature, are occasionally reported. Among the cases attributed by Kelynack[11] to the drinking of contaminated beer were instances of damaged renal tubules and glomeruli; and dysuria was sometimes a presenting symptom.

Arsenic and Cancer

In the past 75 years, the association of chronic iatrogenic arsenic ingestion and cancer has been well documented. On the average, epitheliomata appeared 18 to 20 years (range 3 to 50 years) after therapeutic exposure to arsenic. Keratoses appeared on the average after 8.8 years of exposure, while the period elapsing between the onset of keratoses and the appearance of epitheliomata averaged 9.6 years.[21]

The histology of the lesions is largely squamous in nature, this cell type occurring approximately twice as frequently as the basal-cell carcinomata. These tumors tend to be multiple in occurrence, even more markedly than is the case with the spontaneously occurring epitheliomata, which also are multicentric. The keratotic precancers of arsenic mainly involve the distal extremities, while Bowenoid alterations tend to occur mainly on the trunk.

Cases of extracutaneous occurrence of cancer have been alleged to exist as a result of arsenic ingestion.[22] Until such time as adequate statistical confirmation is available, one takes an untenable position that these are more than chance associations. Since the malignant diseases so frequently occur, the possibility of chance association cannot be eliminated at this time.

Morphologically, keratoses are the characteristic cutaneous manifestation of arsenical intoxication, occurring especially on palms and soles as nodular or horny, corn-like elevations, approximately 2 to 5 mm in diameter. They are situated upon inconstant erythematous halos. Often these keratoses appear fissured, and in those cases with diffuse lesions, the skin appears leathery. Cases manifesting diffuse keratoses may be preceded by hyperhidroses.[21]

Cases of occupational cancer due to arsenic exposure have occurred sporadically. The report of Hill et al.[17] is most definitive in this regard, being based upon a well-controlled statistical and clinical survey. Their study demonstrated a significant association of cutaneous cancer with occupational arsenic exposure, though their additional conclusion that this exposure resulted in pulmonary neoplasia is relatively less secure. If this were a simple cause and effect relationship, one would expect that the long-standing exposure to the oxides and salts of arsenic in smelters and mines would result in more cases of cancer than actually seem to occur.

Arsenic in Biological Material

A wide range of arsenic concentrations in urine has been reported in normal persons (0.014 to 0.25 mg As/liter).[2, 23, 24, 25] As previously noted, multiple sources of ingestion are to be expected. Despite this range, however, levels in excess of 0.2 mg As/liter should be viewed with suspicion. Pinto and McGill[2] have suggested that levels at the reported upper range of normal arsenic excretion may be fallacious unless correction for urinary specific gravity is performed.

Keratin will invariably show greater concentrations of arsenic than will most other tissues. Arsenic in the proximal portions of hair has been detected within thirty hours of ingestion[26] and persists thereafter for months.[27] The persistence of arsenic in the dermal appendages indefinitely following death has real medicolegal connotations. Arsenic in hair normally averages 0.05 mg/100 gm of hair, with a range of 0.025 to 0.088 mg;[28] hence values of arsenic as the trioxide in excess of 0.075 to 0.1 mg/100 gm of hair should be considered as evidence of excessive intake. In acute cases, 1 to 3 mg As/100 gm of hair have been found some weeks after exposure,[26] while fingernail parings have demonstrated levels as high as 8.0 mg/100 gm of nail.[13] The occurrence of a transverse white line across the nail width (Mee's line), which frequently results from exposure to arsenic, is suggestive but not definitive of a diagnosis of arsenic intoxication.

Diagnosis

Neurologic—In alcoholic polyneuropathy, other evidence of chronic ethylation usually occurs, such as the Wernicke-Korsakoff syndrome, delirium tremens, or hepatic cirrhosis. Though the development of arsenic neuropathy

is more rapid than the neurological complication of alcoholism, the differential diagnosis may be difficult. Infectious neuronitis (Guillain-Barré disease) may be confused with arsenical neuropathy, though the latter rarely affects the cranial nerves and more frequently demonstrates sensory alterations. The Guillain-Barré syndrome rarely manifests a distal neuropathy in contrast to arsenic, while the former condition will usually show a spinal fluid lymphocytosis and elevated protein concentration, neither of which is present in arsenic intoxication. The burning or painful sensation in the legs and the gastrointestinal disturbances of diabetes may be confused with the neuropathy of chronic arsenic intoxication. In contrast with arsenic, however, the neuropathy of diabetes rarely affects the upper extremities, whereas the trophic skin manifestations, penetrating ulcers, and arthropathy of diabetes do not occur in arsenic intoxication.

Dermatologic—Because numerous other chronic skin diseases produce lichenification (e.g., contact dermatitis, lichen planus, atrophic dermatitis, stasis dermatitis, lichen simplex chronicus) or hyperpigmentation (stasis dermatitis, atrophic dermatitis, healed pemphigus vulgaris, healed exfoliative dermatitis), the diagnosis of arsenical dermatitis is dependent upon a history of chronic arsenic exposure. Though occupational exposure to certain coal tar derivatives results in pigmentation and/or keratosis, such signs occur almost exclusively upon the exposed body surfaces, e.g., the neck and head or scrotum,[29] and do not tend to occur at multiple sites.[21] In addition, the pigmentation of exposed skin surfaces following exposure to certain coal tar derivatives is a photosensitization process, while the cutaneous pigmentation of chronic arsenic poisoning is independent of exposure to sunlight.

Certain hereditary forms of keratosis punctata may be confused with the multiple horny keratoses of the punctate or warty form of arsenical dermatitis occurring on the palms and soles. This source of confusion may be resolved only after biopsy and/or arsenic determinations in urine or dermal appendages.

Since Addison's disease demonstrates vague gastrointestinal symptomatology and a similar distribution of hyperpigmentation, differentiation of this condition from chronic arsenic intoxication may be difficult. A mild asthenia and a severer neuropathy both occurring in the absence of consistent electrolyte disturbances, however, suggest chronic arsenic intoxication and should serve to eliminate adrenal insufficiency.

In the final analysis, the definitive diagnosis of chronic arsenic intoxication will hinge upon a history of ingestion but more assuredly upon a urinary concentration in excess of 0.2 mg As/liter.

Therapy

The postwar appearance of dimercaprol (BAL) for clinical use has made available for the first time a specific agent for the treatment of arsenic poisoning. Since the necessity of urgent treatment does not usually occur in the treatment of chronic intoxication, a dose of 3 mg/kg of body weight usually suffices. This dose is given by deep intramuscular injection every four hours for the first 2 days, then once or twice daily for the next 9 to 15 days. Dosage and duration of treatment will be dependent largely upon clinical severity and response. Because pain and shock occasionally occur subsequent to the first several injections, the patient should be hospitalized. The latter reaction can be aborted by administration of 0.3 mg of 1:1000 aqueous epinephrine solution immediately before injection of dimercaprol.[2]

The presence of a proliferative lesion in association with arsenic dermatitis requires surgical excision and histologic evaluation, lymph node dissection being required where extension of the primary lesion is demonstrated. If one ascertains that malignant alteration has not occurred, conservative therapy utilizing vitamin A has been indicated. The regimen of Hall[30] calls for 100,000 units daily as a water-soluble oral preparation and weekly injectons of vitamin A in oil by the intramuscular route. In the presence of improvement, this course of therapy is followed for several months.

Prognosis

One may expect proportional neuromuscular return inversely with the degree of severity. The severer cases associated with complete foot drop usually demonstrate permanent weakness of dorsiflexion, while the milder involvements, especially of the upper extremities, usually result in return of neuromuscular function.[13]

Though it is usually stated that dermatologic improvement is satisfactory, a favorable prognosis should be tempered by the consideration that most reports refer to intoxication by organic arsenicals.[31, 32] In contrast, although the dermatitis arising from occupation exposure usually responds favorably to dimercaprol,[2] hyperpigmentation has not responded to treatment with this agent.[30]

The toxic hepatitis of chronic organic arsenic intoxication has not been favorably altered by

dimercaprol,[33] nor have cases of the associated aplastic anemia.[33, 34]

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Industrial Medical Association

THE PRESIDENT'S MESSAGE

D. JOHN LAUER, M.D.

AGAIN planning is underway for the Annual Meeting of the Association. It promises to be as big and colorful as in previous years. As you know, the April meeting is in Rochester, New York. This is the last time that the five participating organizations — AIHA, AAIN, ACGIH, AAID, IMA—will present their programs of scientific papers, exhibits, and social functions as a cooperating unit.

The IMA scientific program begins at 2 o'clock on Monday, April 25, with six individual plant tours. These offer a wide choice for the interests of our members.

On Tuesday morning, four separate clinic presentations are offered. In past years these clinics have been very popular. This year the selection is even broader because of the cooperation of the University of Rochester School of Medicine and Dentistry. The Program Committee, under the chairmanship of Dr. Harry A. Hanson, is offering a fracture clinic, a surgical clinic, a medical clinic, and a dermatological clinic.

The formal sessions of the program begin on Tuesday afternoon in the Rochester War Memorial Auditorium. Dr. William P. Shepard keynotes the conference with the Sappington Memorial Lecture. His address is followed by a panel presentation of the Committee on Medical Care under the chairmanship of Dr. Asa Barnes, which in the past has always been informative, stimulating, and provocative.

Wednesday morning will see the joint meeting of the medical and surgical sections of the IMA covering heart disease and workmen's compensation. It will be handled in the form of a mock trial. Anything can happen here. In the afternoon, Dr. W. Daggett Norwood's committee is presenting a lively panel discussion on radiation injury and workmen's compensation. Today this topic is nationally "front and center." In the late afternoon the IMA will have its annual business meeting, with a brief presentation of committee reports and activities of the Association and the election of officers and directors. In the evening, the Association has its annual banquet. Drs. John L. Norris, James H. Sterner, and their group at Rochester have persuaded the Honorable Arthur A. Flemming, Secretary of Health, Education and Welfare, to be the guest speaker. I must pause here to say that we promise this to be the shortest and pithiest banquet in the Association's history. Let this be appeasement for last year's "marathon!"

Thursday will be divided into medical and surgical sessions. In the medical section, in the morning, the Committee on Mental Health, under the chairmanship of Dr. Delma W. Caldwell, will venture into the area of dramatics by putting on a "psychodrama." Dr. Logan T. Robertson will chair a program giving us a look into world health and industrial medicine. Next will be a report on a long-term follow-up of a large series of periodic health examinations. In the afternoon, the committees on Problem Drinking and on Standards for Vehicle Driving, under the chairmanships of Dr. John F. Jellema and Dr. Harold Brandaleone, respectively, will make their presentations.

In the surgical section, in the morning, the Workmen's Compensation Committee, under the chairmanship of Dr. N. Gillmor Long, will address themselves to the problems of the low back. In the afternoon, Chairman Dr. Max N. Howard and his Committee on Emergency and Disaster Planning will direct a program to their area of concern, an area in which all of us need to have a full store of knowledge.

The Thursday program winds up with a clinical conference under the chairmanship of Dr. Frank Princi and his Committee on Clinical

Toxicology. The clinic will be used as the springboard for their question-and-answer section which this group expects to publish regularly in the JOURNAL OF OCCUPATIONAL MEDICINE.

This year's conference will have an unusually large number of scientific exhibits. One of these will be that of our own History Committee. The present chairman, Dr. Alfred H. Whittaker, and his group have labored nearly 20 years collecting information on the history of the Association. The result is a book, called "Occupational Health in America," which is ready to go to press. In order to insure the success of this publication, the History Committee will demonstrate some of the material that is in the book and will solicit advanced, prepublication subscriptions.

On Sunday, April 24, the day preceding the opening of the conference, there will be all-day organizational meetings of the officers and Board of Directors with the district counselors, committee chairmen, and the officers of the 14 component societies of the IMA. These meetings are all open. The membership is cordially invited.

Case Report

Pulmonary Sensitization to Toluene Diisocyanate

Robert C. Kessler, M.D., Rochester, N. Y.

TOLUENE diisocyanate has been reported to be a potent respiratory tract irritant. The following case is cited to demonstrate the rapid development of severe symptoms following four minimal exposures to polyurethane foaming plastics containing toluene diisocyanate.

The patient, a skilled machinist, has a personal and family history negative for allergies. He has had recurrent episodes of chronic bronchitis and has had pneumonia twice over a 24-year period. He has complained of slight exertional dyspnea of five to six years' duration. His pulmonary function has remained adequate for him to pursue his hobby of skin diving, despite his age of 50 years.

In September, 1958, he began mixing and pouring epoxy resins, polyester resins, and polyurethanes. Work was performed in a walk-in hood that was designed to provide approximately 60 fpm air flow at the hood face. All prepolymers, hardeners, and resins were weighed in disposable containers on scales enclosed in a small exhaust hood located within 3 ft. of the work hood. The components were poured from 5-gal. containers to the measuring container on the scales. When weighing was completed, the components were carried to the large hood where they were mixed and poured.

Since the polyurethane reaction is of short duration and is accompanied by production of a rapidly expanding foam, the mixing and pouring operation allow an exposure of only approximately five minutes.

The patient's only exposures to toluene diisocyanate were on October 10, when 600 gm of polyurethane foaming plastic were mixed and poured; on October 30, when approximately 10 lb. were prepared; and on December 20, when 600 gm. were again utilized. After the exposure of December 20, the patient noted some wheezing and shortness of breath which lasted for about four days. He did not associate this with his work and did not seek medical care.

Immediately after the mixing and pouring of 600 gm. of polyurethane on December 29, he became dyspneic and complained of chest tightness. On arrival in the medical department, he stated that he felt as if he had pneumonia again. Examination revealed rales and rhonchi of both bases, with some wheezing. The chest roentgenogram showed conditions within normal limits. Pulmonary function studies revealed reduction in his vital capacity and timed vital capacity, with significant improvement following the inhalation of 1:100 isopropyl arterenol hydrochloride (Isuprel).

Findings on pulmonary function studies are shown below. The patient was 69½ in. tall and weighed 163 lb. All volumes are corrected to body temperature and saturation (BTPS). The results given are the maximum volumes obtained in three trials.

Date	Vital Capacity, Liters	1-Second Volume, Liters	Per Cent of Vital Capacity
12/29/58	2.88	1.33	46.2
(after Isuprel)	3.66	1.72	47
2/18/59	4.44	2.40	53
4/24/59	4.36	2.35	54

The patient was removed from all toluene diisocyanate exposures and followed with periodic pulmonary function studies which still reveal slight diminution from expected normal values. These findings are considered to be the result of his preexisting chronic pulmonary pathology.

Dr. Kessler is a member of the Medical Department, Eastman Kodak Company, Rochester 4, N. Y.

Editorials

Control of Disability Costs

AT A symposium with the intriguing title, "The Growing Challenge of Disability Control in an Era of Comprehensive Medical Care," the Liberty Mutual Insurance Company was host to a distinguished panel of speakers and an equally imposing audience in Boston last fall.* The keynote was set in a statement by W. Bruce Black, the company's Board Chairman. Said Mr. Black:

> "The extent and cost of disability have tremendous impact upon our economy and society. There has been a growing public demand for protection against the effects of illness and injury, whether occupational or non-occupational. This has resulted in the need for better medical facilities and care, health insurance and other prepayment plans, broadened social laws, negotiation of fringe benefits in industrial labor contracts, and many other developments. These changes have created an attitude of impatience toward the institutions and forces which are concerned with meeting the public demand.
>
> "The grave question has been raised as to whether such elements as industry, insurance, medicine, labor, judiciary, and the public administrative agencies concerned can meet the challenges of more effective control of both the extent and the cost of disability under our private enterprise system."

To this end, then, there ensued two days of panel sessions devoted to such topics as Cardiac Disability, Psychological Complications in Disability, Connective Tissues and Degenerative Diseases of Aging, interspersed with dissertations on The Role of Insurance in the Control of Disability, The Socio-economic Responsibility of Medicine, Government's Role in The Control of Disability, Labor's Role in the More Effective Control of Disability, and the Economic Challenges in Disability Control.

Professional meetings for a number of years now have seen these subjects worked over quite thoroughly. In this instance, however, responsible echelons of management sat side by side with physicians and others concerned with disability costs to listen with keen interest to speakers, lay and medical, present a stimulating spectrum of views, for the most part delightfully free of the usual platitudes.

If one expected pat answers to the control of disability costs, this meeting did not provide them. On the contrary, it became clear that good answers can result only from serious studies over the next several years. As was emphasized by Rene J. Dubos of the Rockefeller Institute for Medical Research, we must discard static concepts. Effective control of disability cost will become possible only as we know more about the basic cause.

This "thinking man's" approach to the control of disability raised our sights from the dollar sign to the continued need for unfettered research. Until the fundamental problems are understood the continuing needs are that day-to-day costs be reasonably met; that legal abuses be legislatively corrected; and that all the devious motivations of patient, physician, and lawyer be understood—and resolved. All of these must be well done if the promise of voluntary health coverage is to be substantially fulfilled.

*Proceedings of the symposium, or copies of individual papers presented, may be obtained without charge from W. SCOTT ALLEN, Assistant Vice President, Liberty Mutual Insurance Co., 175 Berkeley St., Boston 17.

Broken Silence

Like the U.S. Navy, this journal has a silent service: the editorial board. Our highly competent colleagues prefer to work anonymously. We feel compelled, despite this preference, to acknowledge here the singular leadership of Dr. Russell G. Birrell in the development of the articles on "Work in Cold Environments" which begin in this issue. We are grateful to him and to his associates in Canada, England, and the United States for this production.

Book Review

MEDICAL DEPARTMENT, UNITED STATES ARMY. COLD INJURY, GROUND TYPE. Colonel Tom F. Whayne, Professor of Preventive Medicine, School of Medicine, University of Pennsylvania, Philadelphia, and Michael E. De Bakey, M.D., Professor of Surgery and Chairman of Department, Baylor University College of Medicine, Houston. Prepared under direction of Major General S. B. Hays, Surgeon General, United States Army. Editor in chief: Colonel John Boyd Coates, Jr. Associate editor: Elizabeth M. McFetridge, M.A. Office of Surgeon General, Department of Army, Washington, D.C. Cloth. $6.25. Pp. 570, with illustrations. Superintendent of Documents, Govern. Print. Off., Washington 25, 1958.

The serious losses which occurred from cold injury among United States Army troops in World War II, which amounted to 91,000 for the entire war period and which are considered in this book, should not have occurred to this extent. The history of this bitter experience, the status of present knowledge, and the principles of a sound program for future prevention and control detailed in this text should provide an introduction to all medical personnel concerned with this aspect of military medicine. In a reedited form it could reemphasize this knowledge as it should be impressed upon civilian populations. The number and discordance of the views held by different "authorities" eventually were resolved on the scientific basis of evidence toward the end of the war.

At the outbreak of World War II, in 1939, the facts concerning cold injury, widely known outside of the United States and formalized by Kreyberg and others, were as follows: Severe local damage with necrosis due to cold can occur as a result of tissues freezing to ice, as well as after prolonged exposure to low temperatures above freezing; there seemed to be a certain critical temperature below which the tissue destruction is direct and immediate; after thawing of frozen tissues, and after return to normal surrounding temperature of tissues subjected to prolonged cooling, violent vascular reactions occur; inside the vessels corpuscular aggregates had been observed and were believed to be of importance for necrosis and its sequelae of thrombosis, infection, demarcation, and repair if this occurred.

The first three of the foregoing facts are learned empirically by the majority of people living in areas with white winters. The democratic process of formalizing these facts and the difficulty of disseminating information to a population unfamiliar with these effects is documented in the first 300 pages. These facts were simply not known or appreciated.

The account of the award of the Purple Heart for cold injury is illustrative of the perpetual lack of authority at responsible levels, an affliction of most public service, when control and responsibility are often separate entities. The *advice*, both intelligent and informed, of the *responsible* medical officer, the 12th Army Group surgeon, that disciplinary action rather than awards was necessary was diluted to extinction by controlling administrative echelons who debated the issue into the farcical situation where a highly esteemed and coveted award could be given for frostbite while in combat but not for trenchfoot or immersion foot in similar circumstances.

The text would have enhanced value in a future edition were the physiological processes expanded to include some of the scientific evidence bearing on the subject. This could be done at the expense of opinion surveys from which no definitive conclusions could be drawn.

For example, it is apparently not appreciated in the total consideration of cold injury, and particularly under physiological considerations, that if a man is adequately clothed in every respect and one area of the body, hands or face, is exposed to a cold stimulus, there follows a general vasoconstriction response, most evident in the extremities. Even in perfectly adequate footgear there can be a temperature differential of 10 or more degrees Centigrade between the instep and the big toe. The supply of heat from the body has been shut off. If then, the foot gets wet and the insulation breaks down, the foot is subject to cold damage dictated by the severity of the conditions. The effects of further mechanical constriction become obvious. This simple "host" factor if intelligently controlled could reduce the necessity for belaboring secondary relationships between "agent" and "environmental" factors. The nearest approach in the text to this physiological fact was made, of all persons, by a German Officer captured by United States Troops. This is probably what the German on interrogation meant when he "regarded the constitutional makeup of the parasympathetic and sympathetic system as a possible predisposing factor." It is almost ludicrous that this diffident expression of a view by the "enemy" struck the reviewer like a ray of sunshine on an overcast day. It is a shining example of the fact that the demonstration of a principle usually considered to be basic research could and often does pay bigger dividends than millions of dollars worth of "applied" research on third order effects. The astronomical cost, tangible and intangible, of 91,000 cold casualties might emphasize this observation.

In the section on the epidemiology of cold injury, the reviewer gathered the impression that the statisticians were handed masses of data with the instruction to analyze it. It has happened many times. The effort is usually doomed at the start because such studies must be planned *in advance of the data*. For example if one wants to reach

conclusions about weight, one doesn't deliberately collect height data—one measures weights. An effort to sort out the data has been attempted by the application of standard techniques. However, the data, regardless of their volume, were not the "right kind" to assist in resolving the problem, and scoring criteria were obviously unable to rectify inadequate data in the first instance. "The paradoxical finding that the coefficient of weather, which is a basic factor, was entirely insignificant could be explained only by the nature of the data . . . These data were general and incomplete."

It should be clear that statistical analysis is merely a simple test, based on sound mathematical hypothesis, by means of which the chances of reaching a false conclusion may be limited to any desired level of probability. Inherent in any such treatment are the principles of homogeneity and randomness. In the final appraisal, the validity of the findings irrespective of the data must be subject to unequivocal verification. Consistent evidence throughout the text deny these conclusions. It should be more generally appreciated that statistics are limited by the data. They are like a tool which cannot fit every nut. Data must, therefore, be collected in such a way that the statistical treatment is valid.

The statisticians were able to shake off initial restraints and get down to their task in a commendably competent manner by delving into unit experience. No one can quarrel with their summary and final conclusions. Which led the reviewer to the next observation that the United States, and for that matter possibly all NATO countries, are *now* prepared for the catastrophe of World War II. This is perhaps a distressing example of "too little and too late."

It is unfortunate, although forgivable, that in comparisons of United States effort with that of other countries, particularly for home consumption, writers often find it impossible to remain objective. In reporting the experience of Canadian and British troops and comparing a total of 206 cases of cold injury incurred by these troops as against 46,000 cases incurred by United States forces in Europe 1944-1945, it would seem to be mandatory to have a *good* explanation.* Three men made reports in an effort to "explain" the discrepancy, Major Hawley, Major Siple, and Colonel Ladd. All three gave comprehensive reports which included the essential information in slightly different ways.

Major Hawley listed the factors as he saw them. Last on the list was "Discipline and Morale." "The average British soldier was more likely than the United States soldier to do exactly what he was told to do."

Major Siple deserves quotes on two of his reasons: "The British and Canadian Armies fought a holding campaign during most of the winter months and therefore had much less exposure in combat than American troops, *who were pushing forward actively during the same period,*" and "The areas of Holland and northern Belgium, where the British and Canadian Armies did most of their fighting during the winter of 1944-1945, have a good deal of sandy soil, in which drainage is rapid. As a result, these troops did not spend so much time in mud and standing water as did American troops" (which of course, is obvious by simply recalling 206 casualties as against a total of 46,000). "Furthermore these areas are somewhat warmer and drier than the more mountainous areas where American troops fought during the winter 1944-1945. When British and Canadian troops were found to be wearing leather boots not adequate for the wet cold conditions *they were encountering* they were provided with completely waterproof boots." Twenty thousand Canadians of the 1st Canadian Division would summarize this by saying "the mud and the slush was over our ankles and we were issued rubber boots. Much of the time we were fighting from Ducks. The bottom was sandy."

Colonel Ladd has his finger placed on the problem in conference with British Medical officers. "The answer to trenchfoot could be summed up in a single word "discipline." There appears to be, however, a subtle difference between the American and the British usage. To the American, this appears as "British troops did what they were told to do, without asking questions" and "the average British soldier was more likely than the United States soldier to do exactly what he was told to do." This is one trouble with opinion surveys. Things are not always what they seem to be.

For the record, discipline in British and Canadian troops is associated with a high level of training based on experience. The difference between 206 cold casualties and 46,000 can possibly be explained on the simple fact that British and Canadian commanders knew from experience that dry socks and rubber boots were necessary and they saw to it that they were used to the best advantage.

Despite an occasional weakness, the book manages to establish a firm background of a solid character concerning the incidence, epidemiology, and prevention of cold injury. Such a weakness can be illustrated by the following: "Eskimo babies wear no clothes. They are carried in pouches on their mother's backs in skin to skin contact, and they are removed stark naked, in weather far below zero for excretion, feeding and other care, without apparent harm." This may be quite true, but if the authors were to check this statement out with the Canadian Department of National Health and Welfare, they might be disillusioned. Eskimo infant mortality is shocking.

The reference to Eskimo footgear is equally casual. The statement is only partly true that they wear sealskin mukluks. These are worn when the wearer expects wet going, because the sealskin becomes water impermeable. Under dry conditions the Eskimo wears caribou mukluks, which are not water-repellent.

*Of course, neither of the casualty numbers is fully meaningful unless one knows the sizes of the populations at risk.—EDITOR.

It should be a revelation, too, to know that the average longevity of the Eskimo is 35. Alleged acclimatization to the Arctic cold in the light of this fact does not provide a great deal of motivation for the acquisition of this ability. This might require several generations and bring to an abrupt end a long genealogy in the case of some of the participants.

Casual statements like "man is a tropical animal" are misleading, no matter how authoritative. This is a useful hypothesis for the eminent biologist Scholander, who first made this pronouncement. However, removed from the critical atmosphere and essential provisos of the experimental biologist, it immediately circumscribes one's thinking. As a matter of record, man is not a tropical animal. He is a temperate animal graced with a certain amount of intelligence which should permit him to extend his haunts toward both the Poles and the Equator, possibly outer space.

It was the consensus among authorities that research might best be directed toward the study of man as a whole in relation to his environment. The text makes this abundantly clear, and the coordination of research and development is a step in the right direction.

The volume accomplished three tasks: It records the history of cold injury, ground type, among United States troops in World War II; it has summarized what has been learned of the nature of this form of trauma; it formulates the principles of a sound program for its prevention and control in future military operations in cold regions.

Accurate diagnosis in the battalion aid station and other forward installations is of the greatest importance in cold injury. Photographic or clinical documentation of the earliest onset of cold trauma is unfortunately lacking, together with any useful countermeasures. The first contact with the injury by the medical officer was *after* the soldier's injury had progressed at least to the painful stage. At the other end, no reliable form of treatment evolved. In a footnote, the use of heparin in trials in Korea is mentioned. Further controlled studies concerned with treatment remain to be done, and the best medical treatment is yet to be outlined.

If one word with respect to clothing were to be used, it would be "hopeless." With 90 sizes of boots, a multitude of types, and much the same confusion and waste for every other item where style is the keynote, there is, as yet, no room for simplicity and utility. This will have to be achieved. The Russians and the Germans already have achieved it.

It is unfortunate that the conclusions that the authors reach in a relatively few pages in the next to the last chapter are so inconspicuous. This chapter would be stimulating material for all services, particularly senior staff courses, public health organizations, and others having to do with the health and welfare of service and civilian personnel.

The final appraisal of this documented volume is one of deep respect for the authors and the office of the Surgeon General, Department of the Army, Washington. To train a surgical spotlight on one's own efforts to reveal costly, wavering, or unimplemented decisions and lack of basic knowledge can only be dedication in its finest form. It must hurt. Although the book is concerned with morbidity in one sense, it does bring into sharp relief the reassuring fact that the individuals or the nation that can do so are essentially vigorous and healthy. It indicates maturity. —JOHN HUNTER, PH.D.

THE AMERICAN COLLEGE OF PHYSICIANS
will present a postgraduate course
"EARLY DETECTION AND PREVENTION OF DISEASE"
May 9-13, 1960
Philadelphia, Pennsylvania

The course will constitute a critical evaluation of the possibilities and techniques for the prevention or the early diagnosis of disease, and should be particularly valuable for physicians in industry who have responsibilities for the performance or supervision of periodic health maintenance examinations.

NORBERT J. ROBERTS, M.D., and JOHN P. HUBBARD, M.D., are co-directors of the course. It will be conducted by members of the faculties of several schools of medicine in Philadelphia and New York, and by staff members of various clinics and occupational medical services in the area. Registration will be limited to 100. Those who wish to register should do so directly with the American College of Physicians, 4200 Pine Street, Philadelphia 4, Pa. The cost for members of the American College of Physicians is $60; for non-members, $80. (Editor's Note—These prices were revised following our publication of this announcement in our February issue.)

Abstracts of Current Literature

Clinical Toxicology

Coal Miners' Pneumoconiosis. E. S. Reed,* P. O. Wells, and E. H. Wicker. Radiology 71:661 (Nov.) 1958. (*Clark County Memorial Hospital, Jeffersonville, Ind.)

Changes in the lungs of miners, other than classical silicosis, from dusts encountered in the mining of coal have been demonstrated. British investigators have reported on the frequent occurrence of radiological abnormalities, the greatest number of which were present in the miners who worked in the dustiest areas of the mines. Similar radiologic changes were seen in men who worked on the surface at operations such as the cleaning, screening, and loading of coal. The pathologic findings in many cases, however, were not similar to those seen in classical silicosis.

Coal miners' pneumoconiosis is divided into two types: simple and complicated. In the simple type, coal dust is distributed throughout the lungs, resulting in the production of discrete nodules located around the terminal bronchioles and the adjacent vascular structures. The amount of fibrosis is minimal, and the fibrous tissue has a radial disposition instead of the concentric formations of collagen that occur in silicosis. Characteristic areas of "focal emphysema" are found around the nodules. The disease is designated as complicated when coalescence of the nodular lesions is evident. Progressive massive fibrosis is present during this stage; it is characterized by the formation of collagenous nodules from one to several centimeters in diameter, chiefly in the upper lung fields. Superimposed infection, chiefly tuberculosis, is thought to be responsible for the development of the progressive massive fibrosis.

Roentgenologically, the simple form of the disease is characterized by multiple, more or less circular, well-defined opacities 0.5 to 5 mm. in diameter. In many cases, silicosis cannot be differentiated from this disease on the basis of chest films. Accentuated pulmonary markings are frequently associated with the opacities; the authors feel, however, that a diagnosis cannot be made unless the nodular opacities are present.

Chest films of 5,651 patients (2,865 females, 2,786 males) from southeastern Kentucky were studied. Roentgen changes consistent with pneumoconioses were found in 556. A history of mining was obtained from about two-thirds of the males. The length of time spent in mining was given by 317 of the patients with pneumoconiosis. Of these, the average length of time spent in the mines for the 263 patients with simple pneumoconiosis was 34.2 years and 36 years for the 54 patients with complicated pneumoconiosis. The average ages were 56.9 and 65.2 years respectively for the groups.

The classification proposed by the Third International Pneumoconiosis Conference and the classification used by the British Pneumoconiosis Research Unit are presented, as well as illustrations of chest films that are representative of the former classification. —L.H.M.

Acute Lipoid Pneumonitis Due to Aspiration of Pressurized Paint Droplets. H. C. Baron* and B. G. P. Shafiroff. Dis. Chest 36:434 (Oct.) 1959. (*Department of Surgery, College of Medicine, New York, N. Y.)

A 55-year-old man was admitted to the hospital with complaints of fever, night sweats, rapid weight loss, and a productive cough of three weeks' duration. Until six months prior to admission, he worked in the garment industry. At that time, during a period of unemployment, he sprayed paint onto cabinets and refrigerators with an electric paint sprayer in a small unventilated room over a period of 30 days. No respiratory protective device was used. Clinical signs and radiologic findings indicated that an infiltrate and a large abscess were present in the apical and subapical region of the left upper lobe. Various studies were negative for evidence of either tuberculosis or a malignant lesion. A left upper lobectomy and lingulectomy were performed. Diagnoses of lipid pneumonitis, chronic pneumonitis, and abscess of the lung were made, after which chemical studies were carried out in an attempt to determine the characteristics of the lipids. The authors concluded that the patient had a pneumonitis and lung abscess which were secondary to the aspiration of a highly reactive drying oil. It is pointed out that the pathologic condition developed rapidly after a short exposure to the aerosol mist, a course that contrasts sharply with typical case descriptions in the literature, which emphasize chronic exposure to emollient hydrocarbons, such as liquid petrolatum. —L.H.M.

Lead Poisoning of Unusual Origin in Two Children. T. Horner* and S. Hickling. New Zealand M. J. 57:600 (Dec.) 1958. (*Wellington, New Zealand)

This report describes two cases of lead intoxication and two additional cases of increased lead absorption in the same family unit. The problem was one of tracking down the source of lead. Two weeks prior to the onset of severe symptoms in one of the children, the mother had eliminated milk from his diet because of a nasal allergy. She substituted for the milk a lemon-flavored drink made from a purchased concentrate, the latter having a critic acid base. The ingredients, the water, and with the exception of one jug, the utensils concerned were found to be relatively lead-free. This jug was obviously intended for

ornamental use and was glazed with a soft colored glaze. It had been used for mixing and holding the lemon drink, and inspection of the interior of the jug revealed erosion. The original glaze contained 15% of lead. To confirm the fact that lead had been leached out of the glaze, a fresh batch of lemon drink was mixed and stored in the jug for 18 hours. After that time, the liquid was found to have a lead content of 400 ppm.

—A. D.

Dermatology

Ionizing Radiations in Industry. P. M. Crossland.* A.M.A. Arch. Dermat. 80:427 (Oct.) 1959. (*1120 Montgomery Drive, Santa Rosa, Calif.)

Present-day applications and use of ionizing radiation in industry are growing with exceeding rapidity. Because of the interest which dermatologists have in the field of radiation, they should know of the existing and growing potentials so as to be able to detect radiation injury when present in a patient. The physician also has an obligation to assist local, state, and federal public health authorities in handling the present, and exploring the potential, problems associated with ionizing radiations in industry, aggriculture, and medicine. Numerous uses of radiation sources are reviewed. Maximum permissible dose of radiation is stressed, and the current concepts of external and internal hazards from radiation sources are covered in detail.

With the advent of the atomic industrial revolution, better living and the untold opportunities in research are not without a concomitant health problem. However, fear of the radiation problem can be dispelled by practicality in the approaches directed toward control. Studies by the Atomic Energy Commission and other research groups have aided immeasurably in establishing sound control techniques; yet we must be cognizant of human failures and their frequently associated accidents. As the use of radiation sources continues to expand, it may become necessary to undertake some registration and licensing program in order to assure adequate enforcement of safety. These suggestions should not be taken to imply that the state should tell a physician how and when to use ionizing radiation on patients; rather they would assist in assuring safety radiation protection. —D.J.B.

Phototoxicity, Photoallergy, and Photoskin Tests. O. F. Jillson* and W. L. Curwen. A.M.A. Arch. Dermat. 80:678 (Dec.) 1959. (*Department of Dermatology, Hitchcock Clinic, Hanover, N. H.)

Physical hypersensitivity can occur from heat, cold, mechanical, and light stimuli. The commonest of the physical hypersensitivity dermatoses are those produced by light, which has been demonstrated to produce polymorphic eruptions, solar urticaria, contact photodermatitis, and endogenous photochemical dermatitis.

Phototoxic eruptions depend upon a phototoxic material gaining access to the epidermis and then the skin being exposed to wavelengths of light which are absorbed by the phototoxin in the skin. After this type of exposure, erythema, vesicles, or bullae may occur. The authors liken it to an exaggerated sunburn. Phototoxic reactions do not depend upon the person being sensitized to the substance, or a period of incubation being fulfilled. Thus they are not considered to be photoallergic, and, since they do not require oxygen, they are likewise not placed in the category of photodynamic reactions.

In contrast to phototoxic reactions are those due to photoallergy. In this instance, a specific optimal sensitization is established after a period of incubation. The resulting dermatitis can be urticarial, papular, or eczematous. When a patient demonstrates photoallergy, retesting and duplicating the lesions require but a few minutes or hours. The photoallergic reaction has been successfully passively transferred. Further, photoallergic reactions differ from phototoxic reactions in that they do not require specific wavelengths. They can be brought about by alpha rays, by various erythema zones of ultraviolet, or by a phototoxic reaction. However, when a phototoxic stimulus produces a photoallergic reaction, specific wavelengths are required.

The authors review in well-outlined detail the diagnostic use of the carbon arc lamp in which they employed a fixed distance of 6.5 inches from the skin and therapeutic B carbons for a continuous light spectrum. The minimal erythema dose can be determined for each patient, and various wavelengths of light can be delineated by use of filters. These methods can be employed in differentiating phototoxic, photodynamic, photoallergic, and ultraviolet light erythema zones in the diagnosis of dermatoses associated with light. —D.J.B.

Primary Irritation of the Skin: Observations on Threshold Reactions. J. B. Haberlin Jr.* and J. M. Fox. A.M.A. Arch. Dermat. 80:690 (Dec.) 1959. (*Department of Dermatology, University of Illinois College of Medicine, Chicago, Ill.)

It has been well documented that primary irritation can lead to an eczematous dermatitis. In addition, there is experimental and practical clinical evidence to show that the primary irritant reaction can engender an allergic eczematous contact dermatitis. Numerous factors appear to influence the primary irritant reaction; thus in an effort to clarify some of these points which are not distinctly known, the authors undertook a series of experiments to delineate primary irritant reactions.

Guinea pigs were exposed to varied concentrations of two primary irritants, croton oil and chrysarobin, before, during, and after an induced irritant dermatitis. Observations made on the exposed animals indicated that the presence of a massive dermatitis may increase the irritability of the skin in other locations.

In another experiment, the influence of ultraviolet

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irradiation and stripping of the stratum corneum on the threshold of primary irritation of the skin was studied on 10 white male students. From this experiment the authors concluded that the thickness and integrity of the horny layer may have considerable influence on the reactions of the skin to threshold concentrations of primary irritants. —D.J.B.

Environmental Physiology

Maximum Oxygen Intake and Maximum Heart Rate During Strenuous Work. C. H. Wyndham,* N. B. Strydom, J. S. Maritz, J. F. Morrison, J. Peter and Z. U. Potgieter. J. App. Physiol. 14:927, 1959. (*Applied Physiology Laboratory and Mathematical-Statistical Division of the Transvaal and Orange Free State Chamber of Mines, Johannesburg, Union of South Africa)

For each individual there is a rate of strenuous work above which no further uptake of oxygen occurs. Additional energy expenditure is possible but only by anaerobic metabolism. Maximum oxygen intake, therefore, is a useful yardstick for comparing aerobic work capacity in human subjects.

Others have observed that both heart rate and oxygen intake increase linearly with work rate and have proposed heart rate measured at submaximal work loads as a criterion for estimating maximum O_2 intake. The present authors measured heart rate and oxygen consumption in four trained African subjects working on a bicycle ergometer at several rates varying from 2,500 ft-lb./min. to levels beyond their maximum O_2 intake. At least five measurements were made on each subject at each work level. At lower rates of work the curves of heart rate and O_2 intake increase linearly with work but at higher levels the curves become exponential in form, approaching asymptotes representing maximum heart rate and maximum O_2 intake. Heart rate, however, approaches its asymptote more quickly than does oxygen intake. In other words, additional O_2 intake can occur with added effort even when heart rate is maximal. Extrapolation of the linear portion of the heart rate curve plotted against oxygen intake underestimated maximum O_2 intake by 0.34 liters/min. The mean asymptotic value for O_2 consumption in these four subjects was 3.139 liters/min. The mean asymptotic value for heart rate was 178/min. These values varied only 3% or 4% over four months of study.

The authors conclude that the only reliable criterion for estimating maximum O_2 intake is to fit an appropriate curve to experimental data and test its goodness of fit. —D.M.

Maximal Heart Rate During Work in Older Men. I. Astrand,* P-O Astrand and K. Rodahl. J. App. Physiol. 14:562, 1959. (*Lankenau Hospital, Phiiadelphia, Pa.)

Previous studies have shown that young men possess a greater capacity for aerobic work than older men, attaining higher levels of both heart rate and maximum O_2 intake. In this report the authors seek to rule out lack of training and motivation and also to study the role of hypoxia as possible factors accounting for the lower levels in older men.

Each of nine physically trained and highly motivated members of a health club, aged 56-58, performed graded exercises on a bicycle ergometer at weekly intervals until he reached his maximum aerobic work capacity, both while breathing air and also while breathing oxygen. Heart rate, O_2 intake (during air breathing only), and blood lactic acid concentration were measured at each level of work. In four subjects working at 50% of their maximum capacity for 50 minutes, these values reached a steady level after five minutes.

Mean values during maximum work were as follows: heart rate, 163/min.; O_2 intake, 2.24 liters/min.; blood lactic acid, 85 mg %. Flattening of the O_2 intake curve at high work levels and the high blood lactic acid concentration gave evidence that the subjects were working at their true maximum aerobic capacity. Except in one case, oxygen breathing tended to lower rather than raise the heart rate.

Heart rate thus appears to limit the capacity of older men to perform aerobic work at maximum levels. At 50% of maximum capacity, however, older men can work for at least 50 minutes without signs of exhaustion. —D.M.

Experimental Toxicology

Benzene Poisoning. K. Sugahara. Okayama Igakkai Zasshi 70:4099-4140, 1958; Chem. Abst. 53: 13424a (July) 1959.

I. Detoxication and Excretion of Administered Benzene. After i.p. injection into rabbits of 200-500 mg/kg benzene, the benzene concentration in the expired air increased rapidly, reached a maximum 2 hours after injection, and was almost gone 15 hours later. Of the administered dose, 44%-78% was excreted as benzene in the expired air, 3%-18% as ethereal sulfate in the urine, and 3%-17% as phenol in the urine.

II. Influence of Inhaled Benzene on Blood Picture, Ethereal Sulfate Ratio, Phenol in the Urine, and Clinical Symptoms in Rabbits. Inhalation of 5,000-15,000 ppm benzene decreased the number of erythrocytes and leukocytes and Hb content of rabbit blood. The ratio of ethereal sulfate to total sulfate and the amount of free and conjugated phenol in urine increased significantly.

III. The Toxicity of Benzene and Prophylactic Effect of Glucuronolactone on Benzene Poisoning. The LC_{50} of benzene vapor for mice was found to be 8,110 ppm for a two-hour inhalation; for i.p. injection, the LD_{50} was 1.28 mg/kg. Preadminis-

tration of 300 mg/kg glucuronolactone slightly protected the animals against a decrease in blood cells. —R.E.E.

The Toxicity of Methyl Divinyl Acetylene. W. T. Rockhold,* P. G. Wright, and H. E. Stockinger. A.M.A. Arch. Indust. Health 20:151 (Aug.) 1959. (*Eaton Laboratory, Norwich, N. Y.)

Acute toxicity studies on an acetylenic derivative, methyl divinyl acetylene (MDA), revealed an oral LD_{50} of >3.2 gm/kg and an i.p. LD_{50} of >2.0 gm/kg for rats. No irritation resulted from single applications of 0.01 ml to intact skin or 0.25 ml to the eyes. Repeated application of 0.25 ml to the skin (three times daily for three days) produced transient erythema, with no systemic toxic effects. The compound can be classified as "slightly toxic" by these routes. Two-hour inhalation exposures to 500 ppm vapor for seven days and to 1,000 ppm for four days were neither lethal nor toxic to rats. An exposure to air "substantially saturated" with MDA vapor depressed and then completely anesthetized rats within 30 minutes; normal recovery occurred within 1 hour after removal from the MDA atmosphere. —R.E.E.

The Nervous System in Trichloroethylene (Poisoning): An Experimental Study. A. B. Baker.* J. Neuropathol. & Exper. Neurol. 17:649, 1958; Chem. Abst. 53:14314f (Aug. 10) 1959.) (*University of Minnesota, Minneapolis)

Studies of acute inhalation toxicity were carried out on 15 dogs by exposing them to 30,000 ppm trichloroethylene in air. In animals dying after a single exposure, no neuropathological changes were found. After a week or longer of repeated acute exposures, there were scattered neuronal changes, especially in the cerebellar Purkinje cells. Studies of chronic toxicity were performed on 25 dogs exposed to 500-3,000 ppm for two-eight hours /day, five days/week. Three dogs survived total exposures of 60-162 hours. The pathological changes were similar in all cases. Chronic trichloroethylene poisoning appears selectively to destroy the Purkinje cells of the cerebellum. —R.E.E.

Toxicity and Anticholinesterase Activity of Tributyl Phosphorotrithioate (DEF). S. D. Murphy* and K. P. DuBois. A.M.A. Arch. Indust. Health 20: 161-166 (Aug.) 1959. (*University of Chicago)

DEF, a new cotton defoliant, is moderately toxic to mammals by oral administration and intraperitoneal (i.p.) injection. It is well absorbed from the gastrointestinal tract; female rats are about twice as susceptible as males to the acute toxic effects by i.p. injection (LD_{50} values, 210 and 440 mg/kg respectively). Lethal doses induced depression and muscular weakness, and death, associated with respiratory failure, occurred within one to seven days after administration. Rats tolerated repeated daily doses of 50 mg/kg (i.p.) without gross signs of toxicity. Repeated doses of 75 and 100 mg/kg induced deaths. Toxic symptoms differ from those caused by organic phosphorus insecticides, but the compound does exert weak anticholinesterase activity. That toxic action other than cholinesterase inhibition is involved is evidenced by the atypical symptoms and ineffectiveness of atropine as an antidote for DEF. —R.E.E.

Molybdenum Toxicosis in the Rat. R. van Reen,* K. F. Glassford, and J. P. Zagrosky. Res. Report NM 75 01 00. 02.02 17:77-84 (Feb. 20) 1959. (*Naval Medical Research Institute, Bethesda, Md.)

Sodium sulfate was effective in protecting rats from the effects of sodium molybdate toxicity when both were fed in the diet. Sodium citrate, tartrate, acetate, bromide, chloride, and nitrate were not effective. The sulfate was also beneficial when molybdenum toxicity was induced with molybdenum trioxide or molybdenum pentachloride but was not effective against the severe toxicosis caused by potassium thiomolybdate. With a low sulfate level in the diet, as little as 5 mg Mo per 100 gm diet caused reduced growth of weanling rats. Mandibular and maxillary exostoses were seen in rats receiving dietary molybdate —R.E.E

Industrial Hygiene

Research Needs in Air Pollution. V. G. Mackenzie.* Indust. Med. & Surg. 28:491 (Nov.) 1959. (*Assisttant Chief, Research and Development Division, Sanitary Engineering Services, U.S. Public Health Service, Washington, D.C.)

The air pollution panel group found there was full acceptance of the necessity of recognizing the limitations of the atmosphere as a natural resource in diluting and dispersing pollutants which will certainly be reached increasingly in many urban areas unless appropriate preventive action is taken. Specific recommendations were made in the fields of health effects of air pollutants and six committees covering aerosols, chemistry, meteorology, instrumentation, agricultural effects and engineering were established by the Sanitary Engineering Center to investigate those aspects of the problem. No priorities were assigned to these various phases of the air pollution problem, but health effects seemed to have a high priority in everyone's mind. —E.C.R.

Future Problems in Air Pollution Research. L. A. Chambers.* Indust. Med. & Surg. 28:487 (Nov.) 1959. (*Director of Research, Air Pollution Control District, Los Angeles, Calif.)

The author emphasizes the need for long-term planning in air pollution and the inability of local agencies to plan programs beyond two or three budget years. He points out that the supply of air of respirable quality is not unlimited though we are inclined to take air for granted. The pollution problem of the future, in common

with other problems of living together, will have to find its solution in some form of control of population. Perhaps we will have the courage and perspicacity to tackle the job before it is too late. If not, nature has a habit of imposing her own limiting measures, usually in a manner opposite to the philosophies of public health. The environmental factors demanding attention are of two sorts: *(a)* those involving competition for finite amounts of the materials required for human existence, and *(b)* those resulting from accumulation of byproducts of the human utilization of such substances. Thus air, water, and basic nutritional, industrial, transport, and energy requirements become the foci of almost all efforts to maintain health, reasonable living standards, and some comfort in the face of population expansion.
—E.C.R.

Microdetermination of Ozone in Smog Mixtures: Nitrogen Dioxide Equivalent Method. B. E. Saltzman and N. Gilbert. J. Am. Indust. Hyg. A. 20:379 (Oct.) 1959. (*Occupational Health Program, University of Cincinnati, Cincinnati, Ohio)

Since the allowable concentration of ozone has been reduced to 0.1 ppm, the importance of interfering chemicals or substances in mixtures of contaminants has been accentuated. This is particularly true in the study of smog chemistry but also may be a consideration in evaluation of industrial environment both inside and outside the plant. The authors have devised a method based on gas phase reactions in which the ozone converts nitric oxide into nitrogen dioxide. This new method conveniently and specifically determines low concentrations of ozone in polluted air, even in the presence of large amounts of other commonly occurring oxidizing or reducing gases. Better than 95% conversion was obtained in a convenient apparatus when 1 ppm excess nitric oxide and 40 seconds' reaction time were used. In the short time allowed, oxidation of nitric oxide by air and organic oxidants was neglible. Results for pure ozone were in good agreement with those of an iodide reagent. For synthetic smog oxidant mixtures (generated by the ozone reaction with 1-hexene) the method appeared specific for ozone, whereas the iodide reagent also responded to organic oxidants. Such reducing gases as sulfur dioxide and hydrogen sulfide did not appreciably interfere even in 100 to 1 ratio to ozone.
—E.C.R.

The Toxicological Basis of Threshold Limit Values: 4. Theoretical Approach to Prediction of Toxicity of Mixtures. W. L. Ball. J. Am. Indust. Hyg. A. 20:357 (Oct.) 1959.

The author has adapted a technique used for evaluating the toxicity of mixtures to the estimation of the toxicity of vapors encountered in industrial hygiene exposures, and he describes three different types of action from mixtures. First, similar joint action where the components act on the same system in approximately the same manner. Second, independent joint action where the components act on different sites and one chemical reaction has very little effect on the other reaction and no cumulative effect would be expected. Third, synergistic or antagonistic joint action. Mathematical formulas are presented to illustrate each of the above types of response. The impracticability of determining the toxicity of all mixtures makes it imperative that theoretical approaches to the prediction of their toxicity be developed.
—E.C.R.

Internal Medicine

Pitfalls in the Electrocardiographic Diagnosis of Left Ventricular Hypertrophy. A. H. Griep.* Circulation 20:30 (July) 1959. (*Departments of Medicine and Pathology, Massachusetts General Hospital, Boston)

Antemortem electrocardiographic tracings on 200 consecutive patients with proven left ventricular hypertrophy at autopsy were analyzed according to the current criteria of abnormal QRS voltage of Sokolow and Lyon, sloping ST segments and ± T-waves in left ventricular leads and delayed intrinsicoid deflections in the same leads. The series included 63 patients with electrocardiographic changes of bundle branch block and myocardial infarction.

Only 22% of group showed abnormal QRS changes. If cases with bundle branch block and myocardial infarction were excluded, this figure was increased to 32%. The classical ST and T-wave changes of hypertrophy were present in 55% of the group. If bundle branch block and myocardial infarction cases were excluded, diagnostic accuracy increased to 80%. A similar lack of consistency existed when delayed intrinsicoid deflection was used as a criterion.

The author makes the point that present criteria are accurate in making a positive diagnosis of ventricular hypertrophy. He emphasizes, however, that the absence of these electrocardiographic changes does not exclude the presence of anatomic hypertrophy. The existence of a taller R-wave in V_6 than in V_5 is suggested as an additional helpful hint in indicating hypertrophy in the absence of the other criteria.
—J.J.T.

Infection with Atypical Tubercle Bacilli in Graphite Pneumoconiosis. M. J. Hirsch,* I. Kass, W. B. Schaefer, and J. Densy. A.M.A. Arch. Int. Med. 103:814 (May) 1959. (*National Jewish Hospital, 3800 E. Colfax, Denver 6)

A 52-year-old man had worked nine years in a graphite mine in Texas. Mining was by the dry process during the first two years. Some 18 years after termination of this employment, the occurrence of a spontaneous pneumothorax, and later a

pleural effusion, led to the diagnosis of tuberculosis. A two-stage thoracoplasty was followed by apparent recovery, but hemoptysis occurred eight years postoperatively. After chemotherapy for approximately six months, the right upper lobe was resected.

The surgical specimen was diffusely indurated and was dark slate-gray in color. There was a cavity 3.5 by 2 cm with a shaggy, trabeculated lining. It contained some necrotic material and a small calculus and was in communication with a bronchus. Microscopically caseous material, particles of graphite, and typically tuberculous granulation tissue were demonstrated. The tuberculous organism was classified as a nonphotochromogenic one of the "Battery" type. These organisms belong to a heterogeneous and ill-defined group of nonchromogenic mycobacteria which have been previously recognized in the southeastern part of the United States. Like other atypical acid-fast organisms recognized in increasing numbers, these differ from the usual tubercle bacillus in culture characteristics, morphology, pathogenicity for laboratory animals, and response to the usual chemotherapeutic agents.

The authors believe the graphite pneumoconiosis to be a predisposing factor to the tuberculous infection and point out that one of seven previously reported cases was also complicated by acid-fast infection. —L.W.

Blood Pressure and Obesity. H. M. Whyte.* Circulation 19:511 (April) 1959. (*Clinical Research Department, Kenematsu Institute, Sydney Hospital, Sydney, Australia)

Measurements of blood pressure, height, weight, skinfold thicknesses, circumference of the arm, and serum cholesterol were made on 100 men, 20 to 40 years of age. There was a positive correlation between blood pressure and body weight, other factors being held constant. Obesity (judged by the thickness of subcutaneous fat) had no apparent influence on blood pressure except insofar as it affected the total body weight. An increase in body weight of 20 lb without any change in arm circumference was associated with an increase of 10 mm Hg systolic and 7 mm Hg diastolic pressure.

The author's hypothesis is that increased weight with increased bulk of tissue raises energy expenditure and, therefore, cardiac output. The increased cardiac output is forced into an aorta and elastic arterial reservoir that may not have the increased capacity of the peripheral vascular tree. Calculated increased stroke output would raise the blood pressure a predictable amount. The predicted elevations in blood pressure correspond fairly closely with observed values in heavier men.

If the observed rise in blood cholesterol with increased age means increased deposition of this material in arterial walls and loss of volume-elasticity characteristics of the main arterial reservoir, the above change in blood pressure would be enhanced.

The conclusion is that blood pressure is related to weight or bulk of the body, but not to obesity except insofar as it contributes to bulk. To outgrow one's aorta might be one of the dangers of overeating. —J.J.T.

Medical Care Administration

Third-Party Medicine—Past, Present, and Future. C. Costello.* J.A.M.A. 170:164 (Aug. 1) 1959. (*Assistant Professor Surgery, Washington University School of Medicine. St. Louis, Mo.)

It must be kept in mind that there is a difference between medical art and medical economics; the art is a collection of techniques and skills employed in the prevention and treatment of disease. The economics comprehends the usage, conditions, and arrangements under which medical services are available.

The term "third-party" appears in the 1955 edition of the American Medical Association's "Guiding Principles for Evaluation Management and Union Centers," which quotes a statement from the "Principles of Medical Ethics" of the AMA. This statement is apparently the origin of the expression "third-party." while the expression is fairly recent, the practice is as ancient as medicine itself. Doctor and hospital care would not exist as we know them today without a third party. Today, most private hospitals would be in desperate condition without these third-party payers. Approximately two-thirds of all hospital income is paid by third parties.

The oldest management third-party program dates back to 1868 and the oldest union program to 1913. Third-parties include Blue plans, Medicare, VA and other government programs, independent plans, industrial medicine and the widespread Labor Health plans.

The medical profession now eyes the union third party not only with respect to what good it may accomplish but also with alarm for the damage it may do to the standards of medicine if it interferes with the first and second parties and the quality of medical care extended. Some alarm results from the general unpopularity of labor unions and some from the alteration in the traditional private patient-doctor practice. Some are just as alarmed at the ultimate possibility of labor organizations or insurance companies dictating medical policy and medical financing as they were at having federal government dictate in this capacity.

The greatest challenge of our time is how to make high-quality medicine available to all. The physician must be mindful of all people's demand for this care and cooperate in planning with them and their third-party representatives how to make it available to them at a reasonable cost.

The American Medical Association should provide a contract for physicians who accept employ-

ment by a third party which should include the following points: (1) no interference in strictly medical matters and protecting doctor-patient relationships; (2) provision that professional qualifications for participating personnel be determined by the profession without lay interference; (3) assurance that disputes will be settled through joint negotiation and, if necessary, by impartial arbitration. —A.B.

Health Insurance for the Aged. J. F. Follmann Jr.* J.A.M.A. 170:689 (June 6) 1959. (*Director, Information and Research Division, Health Insurance Association of America, New York City)

Insurance companies are using seven principal methods to provide protection against the cost of medical care: (1) continuation of group insurance on older active workers; (2) continuation of group insurance on retired workers and their dependents; (3) conversion of group coverage to individual policy basis on termination of employment; (4) issuance of group insurance on groups of older people; (5) continuation of individual insurance including lifetime guaranteed renewable coverage; (6) new issuance of insurance at advanced ages; and (7) issuance of insurance that becomes paid up at age 65.

The number of persons in the United States 65 years of age or older having some form of health insurance coverage was estimated in 1957 to be 39% of all noninstitutionalized persons. The number of aged owning voluntary health insurance has increased 3% each year between 1952 and 1957. At this rate of increase we could expect 75% coverage by 1965 and 90% coverage by 1970 if we use figures based on those individuals who need and want protection. With the increased public awareness of the value of voluntary health insurance protection and the endeavors to make such insurance available to all present and future retired persons who need and want such protection, the potential rate of increase should exceed this. —A.B.

Noise and Hearing

Critical Evaluation of Audiometric Follow-Up Tests in Industry. F. Bartl.* Noise Control 5:243 (July) 1959. (*Boeing Airplane Co., Seattle, Wash.)

The author points out the cost of follow-up audiograms in a large industry with facilities scattered over a wide area. In his plant an audiometric test booth was placed on wheels and taken into the work areas of the plant. This procedure was estimated to save some $20,000 to $25,000 each year in lost time for the 10,000 to 12,000 workmen tested. Further savings can be achieved if a simplified audiometric test can be substituted for the complete follow-up audiogram. The legal importance of the last industrial audiogram is then pointed out and the question is raised as to what simplified audiometric procedure, if any, is legally acceptable. Two screening tests are considered: (1) the sweep screening test using all test frequencies and (2) the 4000 cps single-frequency threshold test. The author expresses the opinion that "if there should be any close relation between the 4000 cps threshold and the threshold at lower frequencies, and if the relation is such that extrapolation to lower frequencies from the 4000 cps could be esablished, then the 4000 cps single-frequency threshold test could be considered as a possible follow-up test." Two sets of samples of audiometric test data were analyzed. The first set consisted of 1,000 audiograms in which the hearing loss readings at 4000 cps were compared with those at 2000 cps. In general, these data showed that more than 98% of the ears tested showed no greater loss at 2000 cps than at 4000 cps. The one exception was for the range 0 to –10 db hearing loss for 4000 cps—for this group of 100, seven ears showed a greater loss at 2000 cps than at 4000 but six of these ears were within the 0 to 10 db hearing loss range, a range usually considered as normal hearing. Then a hearing loss reading of 15 db at 2000 cps was selected as a criterion for maximum acceptable lass at that frequency, and the percentage of ears showing a loss greater than this as computed for the range of hearing loss reading –10 to +100 db for 4000 cps: When hearing loss (HL) at 4000 was 15 or 20 db, then 6% of the ears showed a HL greater than 15 db at 2000 cps; and when HL at 4000 cps was 35 or 40 db, 22% of these ears showed a HL greater than 15 db. As HL at 4000 cps increased, a larger percentage of the ears showed a HL greater than 15 db at 2000 cps, as one would expect. Another "random" sample of 1,500 ears was analyzed. Some eight tables are used to show the analyses. It was concluded that (1) there is *no* HL at 4000 cps associated with a "beginning of HL at 2000 cps"; (2) as HL at 4000 cps increases, there is a gradual increase in the number of ears with a HL greater than 15 db at 2000 cps; (3) there is no close correlation between "increase of HL" at 4000 cps and "increase of HL" at 2000 cps, and so one cannot predict (numerically) HL at 2000 cps (or lower frequencies) from the HL at 4000 cps; (4) the 4000 cps single-frequency threshold is not adequate for industrial use (primarily for legal reasons).

Abstracter's Note: The author neglected to give data to establish the reliability of his serial audiograms over any period of repetition; hence one cannot estimate the extent to which his data and conclusions are affected by *"wide fluctuations"* in HL readings under conditions where *"no change"* in hearing sensitivity could have occurred. —H.O.P.

Susceptibility and Sex. W. D. Ward,* A. Glorig, and D. L. Sklar. J. Acoust. Soc. America 31:1138 (Aug.) 1959. (*Research Center, Subcommittee on Noise, Los Angeles, Calif.)

Hearing surveys nearly always show that women

have more sensitive hearing than men by the time they are twenty years old and this difference increases with age. The data from the Wisconsin State Fair Survey confirm the above finding but shows no differences between the hearing sensitivity of males and females in the 10-19 year age decade In the 20-29 age decade the difference for the frequencies 3000, 4000, and 6000 cps is about 5 db, for the 25th percentile (the upper limit of the most sensitive 25% of the ears studied). The differences increase at higher age decades. These data suggested a study of temporary threshold shift (TTS) in males and females about 19 years of age. The study was done on an equal group of college men and women. There was no significant difference in the rate of TTS development or amount of TTS after a given length of exposure. Recovery from TTS was not significantly different in the two groups. These data suggest that differential noise exposure rather than differential susceptibility is responsible for the observed differences between the auditory sensitivity of men and women.

—H.O.P.

Radiation Health

Study of Six Cases of Acute Whole-Body Irradiation. H. Jammet, G. Mathe, B. Pendic, J. F. Duplan, B. Maupin, R. Latarjet, D. Kalic, L. Schwarzenberg, Z. Djukic, and J. Vigne (Translation by T. L. Shipman). Rev. franc. etud. clin. et biol. 4:210, 1959. (*Curie Foundation, Paris, France)

On Oct. 15, 1958, at the Vinca, Jugoslavia, center of nuclear studies, six persons were accidentally exposed to large doses of neutrons and gamma rays from a nuclear reactor. Evaluation of radiation doses was difficult and required correlation between the clinical course and physical findings in order to determine the course of therapy. It was estimated that one person received a dose of the order of 1,000 rem; four received between 600 and 1,000 rem, while one received not more than 400 rem. All patients developed the acute radiation syndrome with an initial phase of radiologic shock, a latent period of two to three weeks, and a critical period of three weeks. Epilation occurred in all cases, the onset appearing on the 14th to the 20th day.

"Blood chemistry studies did not indicate definitely any important changes." Conventional supportive therapy consisted in good bedside nursing, balanced diet supplemented with vitamins, antibiotics, and transfusions of whole blood or components as indicated. Carefully conducted blood studies indicated an extremely serious hematological crisis with almost complete bone marrow aplasia in the five most severely exposed patients toward the end of the fourth week.

Five of the exposed patients were getting worse, and so bone marrow transfusions were given to the two most serious ill patients on the 27th day; to two others on the 33rd day, and to the fifth on the 36th day. Adult bone marrow from a single donor amounting to 180 cc to 300 cc (8,500,000,000 to 14,000,000,000 cells) was intravenously injected in each case. The marrow transplant was followed by a spectacular increase in the myeloid cells in the blood, in contrast to the least exposed patient who did not receive a graft. After a post-transfusion period of 48 hours, a rapid improvement occurred in four patients, and they recovered after a long convalescence. The patient who had received the dose estimated at about 1,000 rem died of intestinal complications. The sixth patient, who received the smallest dose, was not given a bone marrow transfusion and recovered spontaneously but slowly.

—W.D.N.

An Epidemiological Study of Congenital Malformations in New York State. J. T. Gentry,* E. Parkhurst, and G. V. Bulin Jr. Am. J. Pub. Health 49: 497 (April) 1959. (*New York State Department of Health, Syracuse)

This epidemiological study applies a statistical method to obtain information on possible long-range effects on man of low-level environmental radiation. All congenital malformations recorded for children born during 1948-1955 in New York State, exclusive of New York City, were correlated with geographical areas containing "probable" versus "unlikely" presence of relatively high levels of natural radioactivity. The malformation rate in rural areas classified as "probable" was 15.8 per 1,000 live births, compared with a rate of 12.9 in the "unlikely" rural areas. The corresponding urban areas were 14.1 and 12.8. Data pertaining to source of public water supply were used to evaluate the relationship between malformation rates, presence of radioactive materials, and drinking water. In communities deriving water from wells and springs, a malformation rate of 16.9 was found in areas of "probable" radioactive materials, compared with 12.9 in "unlikely" areas. Communities utilizing large surface waters had corresponding rates of 12.4 and 11.9.

The association of increased malformation rates with residence in areas of "probable" increased natural radioactivity suggests radiation as an etiological agent, but extensive additional radiological measurements will be required before accurate estimates of this possible relationship can be made.

—G.L.V.

A Geneticist Looks at the Radiation Hazard. W. J. Schull.* Radiology 72:522 (April) 1959. (*University of Michigan Medical School, Ann Arbor)

The geneticist must evaluate the hazard of radiation exposure in terms of entire populations rather than in a specific patient, as does the radiologist. This difference in orientation has led to unfortunate misunderstandings. Plant and animal experimentation points to the basic radiogenetic principles that the yield of gene mutations is linearly related to dose and is independent

of the intensity of the exposure. The latter principle has been challenged by new evidence so reevaluation of genetic risk may be necessary.

Six studies on human populations show a possible method of observing genetic effects. Lethal mutants induced in the sex X-chromosomes cause a shift in the sex ratio of the offspring. Although the studies show an effect consistent with genetic theory, it is not conclusive yet that the results must be due to radiation rather than to other factors.

In discussion of genetic risks from ionizing radiation it is emphasized that we do a serious disservice to science when we permit judgments on fact to be confused with facts. Derivation of a "permissible dose" is such a judgment on fact to equate potential benefits from radiation with possible hazards. It is important to inform the public on both aspects so that proper perspective is maintained. —G.L.V.

Surgery

Successful Replacement of Completely Avulsed Portions of Fingers as Composite Grafts. B. Douglas.* Plastic & Reconst. Surg. 23:213 (March) 1959. (*Vanderbilt University, Nashville, Tenn.)

In 17 cases of partial or complete avulsion of the distal portion of the finger, successful replacement is reported. The sooner the part can be replaced, the less bacterial and proteolytic activities within it. In one case the part was replaced 90 minutes after injury with complete success; in another, after 2 hours 45 minutes, with partial success.

Exact approximation must be performed without offset or rotation, using a binocular loupe to match fingerprint lines, notches, etc. to thus realign closely vessels and nerve filaments. The importance of control of bleeding by tourniquet alone is stressed, avoiding corrosives on the open wound, and using very careful technique of handling of tissues.

In 10 cases bone was completely transected and replaced. In two a portion of tendinous insertion and joint capsule were replaced. In 15 the entire replaced portions survived, the other 2 requiring secondary procedures.

Because of these results, it is emphasized every effort should be made to locate and surgically replace avulsed parts of the distal ends of fingers as first choice, since more complicated procedures cannot hope to match the original tissue. —S.S.

Surgical Management of Injury to the Pancreas. H. Doubilet* and J. H. Mulholland. Ann. Surg. 150:854 (Nov.) 1959. (*Bellevue Hospital, New York, N. Y.)

Certain principles of treatment revolve about the knowledge of dynamics of intraductal flow and of extravasation of pancreatic juice. Surgical treatment involves drainage of the duct of Wirsung by transduodenal sphincterotomy or splinting a damaged duct by a removable plastic catheter, anastomosis of a draining duct to stomach, or if necessary simple drainage of the pancreatic area in preparation for possible secondary procedure.

Extravasated juices if unactivated may give obscure evidences of injury, collecting and manifesting gradual distention or a pseudocyst. Activated juice (activation mechanism is not known) may cause severe inflammatory reaction, erosion, and/or hemorrhage justifying aggressive emergency treatment. —S.S.

Inguinal Hernia: An Anatomic-Surgical Correlation. C. A. Griffith.* S. Clin. North America 39:531 (April) 1959. (*University of Washington, Seattle, Wash.)

The author emphasizes there is no routine operation for hernia repair and stresses the significance of the transversalis fascia. The latter is described in detail, and the iliopubic tract is described as a fusion of the overlying fascia of the iliopsoas muscle and the transversalis fascia running from the anterior iliac spine to the pubis. The iliac fascia between Cooper's ligament and the iliopubic tract covers the femoral ring and prevents femoral hernia.

As in infants, when a narrow indirect sac has not dilated the internal ring and the inguinal floor is strong, high ligation cures the hernia. When the internal ring has been dilated, high ligation plus closure of the ring is required.

When the internal ring is dilated and the inguinal floor weakened, high ligation plus strengthening the floor by plication of the transversalis fascia should be done. This latter technique is described in detail; tranversalis fascia is used superiorly and Cooper's ligament and the iliopubic tract inferiorly. Direct hernias are converted to indirect sacs when possible. If the transversalis fascia about the defect is strong, the floor may be repaired by plication of this structure. If the floor has been destroyed, then transversus abdominus aponeurosis or lateral border of rectus sheath is sutured to Cooper's ligament, tension being relieved by a relaxing incision. If tension is not relieved, then the iliopubic tract with the inguinal ligament should be used instead of Cooper's ligament. The internal ring should be closed laterally by suturing transversalis fascia to the iliopubic tract. —S.S.

Intraperitoneal and Extraperitoneal Neomycin as a Topical and Irrigating Agent. S. Hoffman.* Am. Surgeon 25:170 (March) 1959. (*914 N. Charles St., Baltimore, Md.)

In the light of recent reports of toxicity of neomycin sulfate, this report gives results indicating in the proposed dosage and concentration it has not proved toxic; rather the problem has been one of overdosage. Nephrotoxicity occurs at serum neomycin levels of 0.2 mg/cc. The dose recommended is 1 to 2 mg/kg. of body weight, and 20 to 30 cc. of 0.5% solution only should be used in the peritoneal cavity. —S.S.

About the Authors

EDWARD A. SELLERS, M.D., PH.D., is author of the article "Cold and Its Influence on the Worker," which introduces the assembly of articles on cold effects beginning in this issue. Dr. Sellers is Professor and Head of the Department of Pharmacology at the University of Toronto. He is a member of the Royal Canadian Navy Personnel Research Committee and of the Human Resources Advisory Committee of the Defence Research Board of Canada. He was chairman of the former group, 1954-1957.

DR. SELLERS received the M.D. degree from the University of Manitoba in 1939, and the Ph.D. degree from Toronto in 1947. He was Professor of Physiology at Toronto during 1951-1959 and held a professorship in the Banting and Best Department of Medical Research.

DR. SELLERS' advice was frequently sought in the development of the articles which are now being presented. The experience he brought to the project includes participation on the Panel on Arctic Medicine. He was Advisor on Medical Research and Development to the Medical Director General, the Royal Canadian Navy, in which he also served as Surgeon Commander.

RAINER GOLDSMITH, B.A., M.B., B.CH., graduated from Cambridge University in history and natural sciences before completing his medical training at St. Bartholomew's Hospital, London. After the usual house appointments he joined the R.A.M.C. (the Royal Army Medical Corps), in which he served for two years. Just before his appointment as medical officer and physiologist to the Advance Party of the Commonwealth Trans-Antarctic Expedition, with whom he spent one year in the Antarctic, he joined a large shipping company as surgeon to make a cruise in the Far East. On his return from the Antarctic in 1957, he joined the staff of the Division of Human Physiology of the Medical Research Council, who were the sponsors of the Antarctic physiological program.

In 1958 DR. GOLDSMITH took part in a research project sponsored by the National Science Foundation for the U.S. International Geophysical Year entitled "Operation Snuffles," a project to enquire into the spread of upper respiratory infections in isolated communities; to this end he spent an additional six months in the Antarctic on an ice breaker, the accommodation of which contrasted markedly to that in the tractor crate where he had spent the first winter in the Antarctic. DR. GOLDSMITH is senior author of the article "Polar Expeditions as Human Laboratories."

HAROLD ELLIS LEWIS, B.SC., M.B., CH.B., is associated with Dr. Goldsmith in the authorship of the article "Polar Expeditions as Human Laboratories.

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About the Authors

Born in South Africa, DR. LEWIS graduated from the University of Cape Town. After serving in the South African Army, he went to Britain after World War II to do research in physiology at London University, England. He was appointed to the staff of University College, London, in 1948. In 1952, he was given leave of absence to be Physiologist on the British North Greenland Expedition. It was the first occasion on which medical research was given full status on a British polar expedition. After the Expedition, continuing as an Honorary Lecturer at University College, he was appointed to the staff of the Division of Human Physiology of the Medical Research Council.

With Dr. J. P. Masterton, DR. LEWIS has published papers on aspects of polar physiology and photography. He has contributed sections to "Venture to the Arctic," a Pelican book which describes the scientific work of the Greenland Expedition. He was awarded the Polar medal in 1955. This work has formed the basis for subsequent physiological programs for the Trans-Antarctic Expedition and polar parties in the International Geophysical Year and for bases on the Falkland Islands Dependencies Survey. DR. LEWIS is a contributing author of "Starling's Principles of Human Physiology."

L. H. TURL, PH.D., author of the article "Clothing for Cold Conditions," entered the University of Toronto in 1934, majored in mathematics and physics, and graduated with an Honours B.A. in 1938. He then joined the Ontario Research Foundation, where he did research on the properties of the natural silk fiber and at the same time took graduate courses in physics. He received an M.A. degree in 1939. Extended studies of the silk fiber and further graduate work earned for DR. TURL a Ph.D. degree from the University of Toronto in 1943.

In 1951 DR. TURL accepted his present position as head of the clothing Research Section of Defence Research Medical Laboratories, Toronto. DR. TURL is a Fellow of the Textile Institute, a member of the Fiber Society, and a charter member of the Canadian Association of Physicists. He has served on a number of committees, primarily in the defense field, and is currently a member of the Canadian Government Specifications Board's committee on the Revision of Test Methods for Textiles and on Garment Sizing.

LOREN D. CARLSON, PH.D., is Professor of Physiology in the Department of Physiology and Biophysics at the University of Washington School of Medicine, Seattle. He has for several years carried on research and other work in the general field of physiological responses to cold environments. From this broad background comes his article, "Human Tolerance to Cold."

DR. CARLSON was originally an Iowan. He was born in Davenport and received the B.S. degree from St. Ambrose College in that city. He received the Ph.D. degree in Physiology from the University of Iowa in 1941. He was shortly thereafter commissioned a first lieutenant in the U.S. army and assigned to the Physiology Branch, Aeromedical Laboratory, Wright Field, Ohio. At the close of the war he held the rank of major, and was Oxygen Branch Chief at Wright Field. He then went to the University of Washington where he has carried increasing responsibility in the Department of Physiology as well as various administrative assignments in the University.

DR. CARLSON is a member of the Aero Medical Panel of the Air Force Scientific Advisory Board. In 1957 he was a member of the Subcommittee on Hand Functioning and Handwear, the Committee on Environmental Protection of the National Academy of Sciences—National Research Council.

CHAS. ROMBOLD, M.D., is senior orthopedist on the staff of the Wichita (Kansas) Clinic. In keeping with this journal's compulsion for exactness, correspondence was developed concerning the spelling of his given name. It is correct as it stands.

DR. ROMBOLD received the M.D. degree from Northwestern University Medical School, Chicago in 1924, following which he completed a residency in his specialty at New York Orthopaedic Dispensary and Hospital in New York City. He has been active in the practice of orthopedic surgery in Wichita since 1926. He is certified as a specialist by the American Board of Orthopaedic Surgery, Inc., a Fellow of the American College of Surgeons, and a member of the American Academy of Orthopaedic Surgeons.

DR. ROMBOLD'S article in this issue, "Industrial Back Prevention," is based upon material in a thesis he prepared for admission into the American Orthopaedic Association.

BERTRAM D. DINMAN, M.D., D.Sc., is author of the topical review in this issue entitled "Arsenic: Chronic Human Intoxication." Dr. Dinman is Associate Professor of Preventive Medicine, The Ohio State University College of Medicine, at Columbus.

DR. DINMAN is a graduate of Central High School and Temple University, Philadelphia. His college work was interrupted by service in the U.S. Army. During this service he had opportunities to attend Schrivenham Army University, England (1945), and Biarritz Army University, France (1946). He received the M.D. degree from Temple in 1951. After an internship and training in internal medicine at the Einstein Medical Center in Philadelphia he briefly practiced internal medicine in that city.

DR. DINMAN entered graduate training in occupational medicine at the University of Cincinnati in 1954. After three years of work, which included a rotation of services through various plants and laboratories of E.I. du Pont de Nemours and Company, he received the D.Sc. degree from the University of Cincinnati in 1957. He joined the faculty at Ohio in the same year.

DR. DINMAN is on the attending staff of University Hospital, Columbus. He is Chairman of the Medical Advisory Board, School Employees Retirement System of the State of Ohio, and Consultant in Occupational Medicine to the Western Electric Company at Columbus. —EDITOR

People and Events

► The Twelfth Annual Meeting of the American Academy of Occupational Medicine was held at the Williamsburg Inn, Williamsburg, Virginia, on February 11, 12 and 13. Selection of Williamsburg represented a departure from the Academy's usual practice of holding annual meetings in large metropolitan centers. A second innovation was in having a large proportion of the papers presented by members of the Academy, rather than relying almost entirely upon invited speakers.

The experiment was eminently successful as demonstrated by the large attendance, the high calibre of the scientific sessions and an atmosphere which was conducive to discussion among informal groups. Total registration reached 150, which represents about one-half of the Academy membership.

Among the highlights of the scientific portion of the meeting was a paper on "Man in Space" by WILLIAM AUGERSON, M.D., of the National Aeronautic and Space Administration, followed by a visit to the NASA research center at Langley Field, Virginia. A symposium on "The Hazard to Health in the Hydrogenation of Coal" illustrated the effectiveness of coordinating research, medical control and industrial hygiene practice in setting up adequate safeguards to health in a new technological process. This symposium was presented by industrial health personnel of the Union Carbide Chemicals Company: RICHARD J. SEXTON, M.D., Medical Director, Institute, West Virginia plant; CARROLL S. WEIL, Senior Industrial Fellow at Mellon Institute; and N. H. KETCHAM and R. W. NORTON, company industrial hygienists.

Joseph A. Quigley, M.D.

A memorial address in honor of the late GEORGE H. GEHRMANN, M.D., was delivered by ROBERT A. KEHOE, M.D. "POP" GEHRMANN is recognized as the Father of the Academy, which is one of many great accomplishments of the beloved founder of the organization. At the annual dinner, WILLIAM P. SHEPARD, M.D., Chief Medical Director of the Metropolitan Life Insurance Company, delivered the annual Gehrmann Lecture. DR. SHEPARD'S topic was "A Medical Director's Views on Retirement."

Another highlight of the program was the presentation of the Annual Academy Award to ADOLPH G. KAMMER, M.D., of the University of Pittsburgh Graduate School of Public Health. The award, a bronze plaque, was made particularly in recognition of DR. KAMMER'S part in developing an outstanding program of teaching and research at the University of Pittsburgh and in his editorship of the JOURNAL OF OCCUPATIONAL MEDICINE. The Award was presented by LEONARD J. GOLDWATER, M.D., Professor of Occupational Medicine at Columbia University, retiring President of the Academy.

At the close of the annual business meeting the presidency was assumed by JOSEPH A. QUIGLEY, M.D., Medical Director of the Na-

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tional Lead Company, Cincinnati, Ohio. Other officers elected at the meeting are as follows: JOHN L. NORRIS, M.D., Vice-President; PAUL J. WHITAKER, M.D., Secretary; and JACK H. WOLFSIE, M.D., Treasurer. GEORGE F. WILKINS, M.D., was elected to a three-year term as a Director.

► WILLIAM J. GALLO, M.D., has been appointed Supervisor of Health and Safety at the Pratt & Whitney Aircraft Florida Research and Development Center. He is the first full-time physician employed by the plant.

DR. GALLO received his A.B. degree from Colgate University in 1929 and his M.D. degree from Columbia University in 1933. He served his internship at Fordham Hospital, New York and his residency at St. Francis Hospital, Miami Beach.

DR. GALLO was employed by Republic Aviation Corp. at Manorhaven, N.Y., from 1953-58. His additional experience in industrial medicine includes two years with United Aircraft Corporation at East Hartford and Stratford, Conn., and two years at Hartford with the Connecticut Department of Education, Division of Rehabilitation. He is a member of the Industrial Medical Association and the American Medical Association.

► ARTHUR F. STRANDBERG, M.D., has joined the medical department of the Procter and Gamble Company in Cincinnati on a full-time basis.

DR. STRANDBERG received his B.S. degree from the University of Washington in Seattle in 1951 and his M.D. degree from the University of Cincinnati in 1955. He interned at Cincinnati General Hospital from 1955 to 1956. He spent the next two years in the U.S. Army with duty as the medical officer for an isolated post in Alaska. Prior to discharge he was awarded the Commendation Ribbon with Metal Pendant.

He is a member of the Industrial Medical Association, the American Medical Association and the Ohio State Medical Association.

► WILLIAM P. ECKES, M.D., who has been Executive Director of the Medical Department for Consolidated Edison Company of New York, has been elevated to the position of Assistant Vice President. Appointed to the position of Executive Director is S. CHARLES FRANCO, M.D., who has been Associate Medical Director. JOSEPH E. WARREN, M.D., who joined the medical staff of Consolidated Edison in 1956, has been appointed Assistant Medical Director.

DR. ECKES received his M.D. degree from New York Medical College in 1920 and interned at Jamaica Hospital in New York. He has been affiliated with Consolidated Edison since 1926. He is a Fellow of the Industrial Medical Associa-

tion, the American College of Surgeons, the International College of Surgeons and the American Medical Association.

DR. FRANCO completed his undergraduate work at Columbia University and obtained his M.D. degree from Long Island College of Medicine in 1931. He interned at Long Island College Hospital and joined Consolidated Edison in 1935 as a consultant in internal medicine. He is a Director of the Industrial Medical Association, and a Fellow of the American College of Physicians and the American Medical Association.

DR. WARREN completed his pre-medical education at St. John's University with a B.S. degree in 1948, after an interruption of studies for three years while serving with the armed forces in Europe during World War II. He received his M.D. degree from New York University-Bellevue Medical Center in 1952. His training included internship and residency in internal medicine and cardiology from 1952 to 1955. He was a resident-fellow in cardiology at St. Francis Cardiac Hospital, Roslyn, Long Island, in 1955. He is a Diplomate of the American Board of Internal Medicine and Cardiology.

► FREDERICK FINK, M.D., has been appointed Medical Director of the Semi-Conductor-Components Division of Texas Instruments, Inc., in Dallas. DR. FINK received his M.D. degree from University of Texas in 1923 and interned at Philadelphia General Hospital. He has served as Medical Director for a number of insurance companies on a part- and full-time basis. From 1941 to 1945, he was Chief of the Development Section, Research and Development Division, in Office of the Surgeon General of the Army. He joined the medical staff of Chance Vought Aircraft in 1953 and held the position of Plant Physician until his present appointment.

► EDMUND V. CURRIE, M.D., has been appointed Senior Medical Officer of the Northern Electric Company, Ltd., in Montreal, according to MILTON G. TOWNSEND, M.D., Medical Director. DR. CURRIE has been associated with Northern Electric since 1954.

Pictured at the annual Christmas party of the Section of Industrial Medicine and Surgery of the Los Angeles County Medical Association are Dudley M. Cobb, M.D.; Leon O. Desimone, M.D.; Packard Thurber, M.D.; Willard I. Nesson, M.D.; Herbert J. Kirchner, M.D.; Jerome W. Shilling, M.D.; Robert C. Rossberg, M.D. (Santa Claus); John D. Gillis, M.D.; Willis L. Jacobus, M.D.; C. H. McCallister, M.D.; Clarence L. Lloyd, M.D.; Orwyn H. Ellis, M.D.; Peter Hoffman, M.D.; Morris L. Goren, M.D.; and Ruben Weingarten, M.D.

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He completed his undergraduate work at the University of Saskatchewan and received his M.D. degree from the University of Toronto in 1949. Following his internship at Toronto Western Hospital, DR. CURRIE entered private practice in Shelburn, Ontario. He did postgraduate work at the University of Toronto and received a Diploma in Public Health in 1952.

DR. CURRIE is a member of the Industrial Medical Association, the Industrial Medical Association of the Province of Quebec, Canadian Public Health Association and the Canadian Medical Association.

► Four units of Kimberly-Clark Corporation were awarded the Occupational Health Institute's Certificate of Health Maintenance on January 14. E. L. BELKNAP, M.D., OHI regional consultant, and professor at Marquette University Medical School, presented the certificates to Atlas and Neenah Mills, Main Office and Kimlark (Field Service and Staff Engineering). GORDON PETERSEN, M.D., Corporation Medical Director, attended the presentation ceremonies and introduced DR. BELKNAP to staff officials and union representatives at each unit. DR. PETERSEN credited a large measure of the success of the company's health program to the support and confidence of labor as well as management.

► FOWLER F. WHITE, M.D., recently has assumed his duties as Medical Director for The Torrington Company, Torrington, Conn.

DR. WHITE received his M.D. degree from the University of Maryland in 1950, and interned at Mercy Hospital in Baltimore. He served with the U.S. Air Force from 1951 to 1953. He then joined the medical staff of the Hamilton Standard Division, United Aircraft Corporation in West Hartford, Conn., where he remained until 1957. He is a member of the Industrial Medical Association.

► DR. DETLEV W. BRONK, president of the Rockefeller Institute and of the National Academy of Sciences, will present the annual LOUIS H. BAUER lecture at the Aerospace Medical Association's 31st annual meeting at the Americana Hotel, Miami Beach, Florida, May 9, 10, and 11. More than 100 papers covering all aspects of aerospace medicine and research comprise the scientific program of the meeting, according to LUDWIG G. LEDERER, M.D., president of the Association. DR. LEDERER is Medical Director of Capital Airlines and Physician-in-Chief of the Washington National Airport. At the close of the 1960 meeting, GEORGE J. KIDERA, M.D., Medical Director of United Air Lines, will be installed as the Association's new president.

► Western New York Society of Industrial Medicine and Surgery has elected the following officers and directors to take office on April 1: JAMES H. MCDONOUGH, M.D., President; MARVIN L. AMDUR, M.D., President-Elect; GORDON M. HEMMETT, M.D., Vice-President; GEORGE A. HARDIE, M.D., Secretary; ELSA K. CHAFFEE, M.D., Treasurer; directors for two year terms—DALLAS E. BILLMAN, M.D., and WILLIAM F. NARDONE, M.D.; directors for one year terms — JOSEPH C. KLEIN, M.D., and ROBERT H. MEHNERT, M.D.

► The Third Annual Occupational Health Conference was held in Vancouver, British Columbia, on February 26 and 27 under the sponsorship of the Greater Vancouver Health League, the Vancouver and District Labour Council, and the Vancouver Board of Trade.

Following the opening ceremonies, a keynote panel discussed "A New View on Employee Health and Labor Management Objectives." The panel included THE HON. J. V. CLYNE, Chairman of the Board, MacMillan, Bloedel and Powell River, Ltd., CHRIS PRITCHARD, labor representative, RAYMOND JONES, Vice-President, MacMillan, Bloedel and Powell River, Ltd., and L. E. CURTIS, M.D., Regional Medical Director, Standard Oil Company of California.

Other speakers and subjects presented were: "A Social Worker's View on Health and Progress in an Industrial Society" — PROF. WILLIAM A. DIXON, Head of the School of Social Work, University of British Columbia; "Impressions of Some Rehabilitation Services in the United Kingdom" — G. F. AMYAT, M.D., Deputy Minister of Health, British Columbia; "European Occupational Health Programs — Practices and Attitudes" — T. H. PATTERSON, M.D., Chief, Occupational Health Division, Department of National Health and Welfare, Ottawa; "Maximum Utilization of the Epileptic in Industry"—JOHN DICK, M.D., Medical Director, The Epi-

lepsy Centre, Vancouver; "Is Labor Satisfied?" — WILLIAM EARHART, Manager, Teamsters Health & Welfare Association, Teamsters Union, Portland, Oregon; "Can the Health Professions Produce More Disease than They Cure?"—J. S. TYHURST, M.D., Head of the Department of Psychiatry, University of British Columbia; "Can the Costs of Occupational Health Programs Be Justified?"—HUGH C. WILKINSON, Associate Professor and Chairman of the Division of Production, Faculty of Commerce and Business Administration, University of British Columbia; "Where Is the Future Manpower?" — J. F. MCCREARY, M.D., Dean of the Faculty of Medicine, University of British Columbia; "Human Factors Affecting Mental Health and Productivity"—STANLEY GREENHILL, Professor of Social and Preventive Medicine, University of Alberta; "What Is a Full Concept of Employee Health in Relation to Labor, Management and the Health Professions?" — L. E. CURTIS, M.D., Regional Medical Director, Standard Oil Company of California.

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The rapid and convenient route to prevent or relieve inflammation, reduce swelling and pain, promote healing.

WHAT IT IS:

Chymar Buccal is a tablet specifically formulated for buccal absorption containing purified chymotrypsin extracted from mammalian pancreas. Each tablet contains 10,000 Armour Units of proteolytic activity.

WHAT IT DOES:

Chymar Buccal counteracts, reduces, prevents inflammation of all types. It prevents or reduces edema, hastens absorption of hematomas, thus restores impaired local circulation and reduces pain.

HOW SUPPLIED:

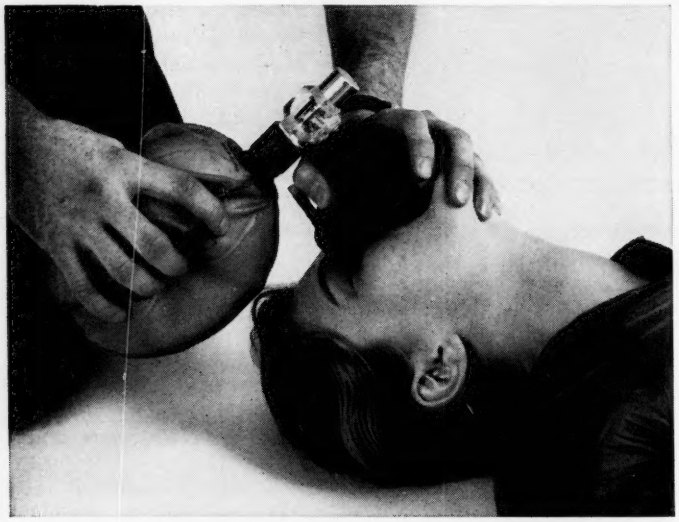
Chymar Buccal is available in bottles of 24 tablets.

Stock No. 2323 — Industrial Price — $4.62 per bottle of 24 tablets

Distributed by: ***Chymar, the superior systemic anti-inflammatory***

MIDWEST HOSPITAL & SURGICAL SUPPLY CO.

7209 South Halsted Street Chicago (21) Ill. Hudson 3-2066-7



when seconds count . . .

AMBU*

to restore the breath of life

the *AMBU* Resuscitation and Suction Kit in respiratory emergencies—

- **always ready for instant use**
- **efficient and simple to operate**
- **no time-wasting set up**
- **compact, portable**
- **no electricity or compressed gases required**

Suction pump is foot operated

*Trademark

For additional information write Air-Shields, Inc., Hatboro, Pa., or phone collect: OSborne 5-5200.

AIR-SHIELDS, INC.

Hatboro, Pa.